MODEL QUESTION PAPER

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION

BRANCH: AERONAUTICAL ENGINEERING

(2013 SCHEME)

13.806.6 : AERODYNAMIC TESTING FACILITIES

Time : Three hours ***Maximum Marks: 100***

(a) Use of electronic calculators is permitted
*(b) This question paper contains **4** pages*
(c) Any missing data can be assumed suitably
(d) Gas dynamic tables must be provided
(e) Answers should be brief and to the point

PART-A

*(a) Answer all the **10** questions*
*(b) Each question carries **2** Marks*

1) Define *Energy Ratio (ER)* of a wind tunnel and mention its normal range of values
2) What are parameters that indicate the wind tunnel test section *flow-quality*?
3) Explain why very high speed tunnels has to be necessarily of *intermittent blow-down type*.
4) Explain why the test section walls of a *transonic tunnel* areperforated?
5) Explain why there exists an optimum expansion angle for a wind tunnel diffuser.
6) A supersonic wind tunnel has square test section of side 1.2 meters. What is the throat size of a nozzle to create a Mach number of 3.3 at the testsection?
7) Explain briefly the working principle of an ultrasonic flow meter
8) What are the major problems encountered during flights re-entering into the earth's atmosphere ?
9) What are the principal advantages of Hot wire Anemometer ?
10) What is Turbulence factor and briefly explain how it is determined.

(10 x 2 =20 marks)

PART-B

(a) *Answer four fullquestions,choosing only one question from each module*

(b) *Each question carries **20** Marks*

MODULE-I

11)

(a) With the help of a neat diagram, explain the major components of a simple open circuit low speed wind tunnel. **(10)**

(b) What is taper ratio of a wing ?What is its effect on the span-wise lift distribution? Explain whylarge taper ratios are not desirable. **(10)**

OR

12)

(a)A 0.3 m x 0.3 m , Mach 2 supersonic wind tunnel is being supplied from a high pressure 20 m^3 storage tank. The initial pressure and temperature in the tank are 30 atmospheres and 25deg C and it is equipped with enough heat sink materials. Assuming that the starting pressure ratio for the tunnel is 3.0 and that the pressure loss in the pressure regulating valve is 40 % , estimate the runtime of the wind tunnel. What will be the runtime, if the tank is charged to only 20 atmospheres initially ? **(10)**

(b) Explain how the lift coefficient C_L and drag coefficient C_D can be determined from surface static pressure measurements around the airfoil**. (5)**

(c) How flow angularity in the wind tunnel test section can be determined with a yaw probe**?** **(5)**

MODULE-II

13)

(a) Determine the minimum possible diffuser contraction ratio and the power required for a two stage compressor to run a closed circuit supersonic M=2.2 wind tunnel Assume compressor efficiency of 85 % and delivery pressure of 4 atm. The throat area of the nozzle is 0.04 sq. m and total temperature of air is 330 deg K **(12)**

(b) Explain how the Mach number at the wind tunnel test section can be determined by using a Mach Number wedge probe. What are the limitations of this method? **(8)**

OR

14)

(a Explain in detail the starting problem of a supersonic wind tunnel and how the second throat area can be suitable designed. **(10)**

(b) Explain how the drag of a body can be determined by measuring the velocity profile in the wake by means of rake? **(10)**

MODULE-III

15)

(a Explain with the help of neat sketches how the Laser Doppler Anemometer can be used to measure velocity fluctuations in a turbulent flow field.

(12)

(b) Explain the use of radiation pyrometers for measuring the temperatures in a combustion chamber **(8)**

OR

16)

(a) Explain the working principle of Rotameters and the use of the non-dimensional parameter Ruppel Number in calibrating them.

(12)

(b) Explain different types of pressure transducers and how these can be used for measuring static pressures on the wind tunnel models? **(8)**

MODULE-IV

17)

(a) Explain the pitot static tube correction for measuring subsonic and supersonic Mach Numbers.

(**10)**

(b) Explain how the drag coefficient CD can be determined from the measurement of wall shear stress **(10)**

OR

18)

(a) What is the maximum Mach Number that can be achieved by expanding ambient air at 300 deg K, if the condensation temperature of air is around 80 deg K**?**

(8)

(b) Explain the problems that are encountered in hypersonic re-entry flight into the atmosphere and how these can be addressed **(12)**

(4 X 20 = 80 marks)