Code No: RR312104 **Set No.1**

III B.Tech. I Semester Supplementary Examinations, May -2005
WIND TUNNEL TECHNIQUIES
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The lift force on a 2-D flat plate model depends upon the relative velocity V, chord C, properties of the air medium like density and viscosity, apart from its angle of attack. Obtain a set of PI groups that can be used to correlate the experimental data.

2. Show with good sketches a comparison of the aerodynamics of a closed ckt , open jet wind tunnel with an open test section ,open ckt wind tunnel for the same capabilities. Which of the two is economical in the longer run? Illustrate with reference to operational charges and fabrication cost.

3. Explain the starting process of a supersonic wind tunnel with a model kept in it with its aerodynamic details.

4. What causes angularity of flow in an otherwise well designed wind tunnel? What are various techniques of measuring the flow angularity? Explain each method with a good sketch and reliability of the results.

5. What is the underlying principle of a pressure manometer? Explain its functioning. Describe an electronic manometer for recording pressures simultaneously from multiple pressure ports with neat sketches.

6. Explain the principle underlying the design and functioning of a strain gauge balance for use in a supersonic wind tunnel. Illustrate the arrangement of strain gauges and the beam of the balance in measuring lift, drag and pitching moments on an airplane model. Show what you write with sketches and diagrams.

7. Describe a smoke generating technique using kerosene for producing smoke in a smoke tunnel. Utilize this technique for observing flow over a circular cylinder spanning the test section. Produce a realistic looking record for explaining the phenomenon of separation of flow to students in the laboratory; with good sketches. Is there any limitation of speed?

8. Explain the Dye Injection technique of flow visualization in wind tunnel testing. How far is this technique superior to any other flow viewing method? Provide its application with one example and illustrate it with good sketches and plots.

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Code No: RR312104 **Set No.2**

III B.Tech. I Semester Supplementary Examinations, May -2005
WIND TUNNEL TECHNIQUIES
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The drag of a sonar transducer is to be predicted based on wind tunnel tests. The prototype is a 37.5 cm diameter sphere to be towed at 5 knots in a tow tank at 15 C. The wind tunnel model is 15 cm diameter sphere. Determine the test speed in wind tunnel. Take ρ_{water} as 1000Kg / m^3 and μ_{water} as 1* 10^{-3} Pa s . The drag of the model was measured as 35 N. Estimate the drag of the prototype.

2. What is understood by the term low speed wind tunnel in aerodynamic testing? Describe with brief details through sketches and plots, various types of low speed wind tunnels based upon the details of the flow in test section. Hence explain a closed section, suction type wind tunnel with all details.

3. Describe a Blow Down type supersonic wind tunnel with a good diagram for explaining each component with its function and necessity for obtaining the desired objectives. How is it superior to an In draft type wind tunnel?

4. What kind of necessity arises for the speed setting of a low speed wind tunnel? How is this testing useful for the users of the tunnel? Explain the theory and procedure in its details.

5. Describe with sketches four different types of pressure manometers commonly used in Aerodynamics laboratories for recording pressures from wind tunnel testing.

6. What types of wind tunnel balances are used to ascertain forces and moments on an airplane model in a low speed wind tunnel? Hence describe the underlying principles of an internal type wind tunnel balance for measuring lift, drag and pitching moments over a finite span wing. Provide all details with sketches and plots.

7. Describe the liquid paraffin smoke wire technique for creating a smoke sheet in the test section of a wind tunnel. Explain its superiority over the kerosene generated smoke technique. Hence utilize this technique to observe flow over a 2D wing spanning the test section at various angles of attack for explaining the flow over an airfoil to students in the aerodynamics laboratory with good sketches.

8. Explain the superiority of oil flow visualization technique over some other surface flow visualization techniques. What are the factors that contribute to realistic results from this technique? Apply this method for viewing flow over a 2D wing model for ascertaining the location of separation point in laminar and turbulent flows and present the results in the form of good sketches. How do you obtain turbulent flow at the same speed setting on the same model?

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Code No: RR312104 **Set No.3**

III B.Tech. I Semester Supplementary Examinations, May -2005
WIND TUNNEL TECHNIQUIES
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The drag of a sonar transducer is to be predicted based on wind tunnel tests. The prototype is a 35 cm diameter sphere to be towed at 5 knots in a tow tank at 15 C. The wind tunnel model is 15 cm diameter sphere. Determine the test speed in wind tunnel. Take ρ_{water} as 1000Kg / m^3 and μ_{water} as 1* 10^{-3} Pa s .The drag of the model was measured as 29 N. Estimate the drag of the prototype.

2. How does a suction type low speed wind tunnel differ from a blower type low speed wind tunnel, both in design and aerodynamics? Describe the superiority of each type in operation and other details of flow characteristics with sketches and diagrams.

3. Why should the test section of a transonic wind tunnel be with perforated walls? Hence show with sketches and diagrams an arrangement of a transonic tunnel.

4. An airplane model is required to be tested in an open jet low speed wind tunnel. Establish a complete picture of the distribution of pressure and velocity distribution in the test section and hence explain the use of these plots while qualifying your results for presenting the same to the design group. Make use of sketches and plots for elaborating each step involved.

5. Explain the principle, functioning and use of a pressure transducer in measuring pressure in wind tunnels. Hence describe one such pressure recording device in details with sketches.

6. Describe a platform type external balance with line diagrams and sketches for measuring lift , drag , and pitching moments (3-components) on airplane and missile models. Draw good sketches and plots in support of your answer.

7. Describe a smoke generating technique using kerosene for producing smoke in a smoke tunnel. Utilize this technique for observing flow over a circular cylinder spanning the test section. Produce a realistic looking record for explaining the phenomenon of separation of flow in a laminar flow and a turbulent flow to students in the laboratory; with good sketches. What are the observations?

8. It is well known that measurement or visualization of a supersonic flow velocity is related to changes in the density of the medium. Describe the underlying principle of optical methods of flow visualization. Hence illustrate the functioning and details of the Shadowgraph system to visualize flow in a supersonic stream and explain why the knife-edge is not required in this case. What if it is inserted in the system? Make use of good sketches to elaborate your answer.

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Code No: RR312104 **Set No.4**

III B.Tech. I Semester Supplementary Examinations, May -2005
WIND TUNNEL TECHNIQUIES
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What is the significance of non dimensional parameters in aerodynamic testing? Explain the importance and effect of Mach number on aerodynamic characteristics of a model under testing in a wind tunnel. Hence state the PI theorem and work out dimensionless groups upon which depend the aerodynamic characteristics of a model under tests in a wind tunnel.

2. A low turbulence wind tunnel is to be designed for laminar flow in the test section. Suggest ways and means to achieve the desired flow quality .How does the arrangement effect the power requirements in the process. Provide a layout sketch in support of your proposal.

3. Show with a detailed sketch salient features of a continuous type supersonic wind tunnel. What are its similarities with a continuous, return type subsonic tunnel; explain with a sketch.

4. What is the cause of horizontal buoyancy on the drag obtained from a wind tunnel test section? What is the difference in results from a closed jet test section and open jet test section? Obtain an expression for the same.

5. Describe the basis for the measurement of pressure and instruments used for the purpose. What are its advantages and applications? Illustrate with theory and an example. Hence explain one method of measuring all parameters in the flow past a rotating circular cylinder kept in a uniform stream of air in a wind tunnel.

6. Explain the principle underlying the design and functioning of a strain gauge balance for use in a supersonic wind tunnel. Illustrate the arrangement of strain gauges and the beam of the balance in measuring lift, drag and pitching moments on an airplane model. Show what you write with sketches and diagrams.

7. Describe a smoke generating technique using kerosene for producing smoke in a smoke tunnel. Utilize this technique for observing flow over a 2D wing at angles of attack up to stalling .Produce a realistic looking record for explaining the phenomenon of stalling to students in the laboratory; with good sketches. Is there any limitation of speed?

8. Explain the superiority of oil flow visualization technique over some other surface flow visualization techniques. What are the factors that contribute to realistic results from this technique? Apply this method for viewing stalled flow over a complete airplane model sting mounted in the test section with pitch-changing mechanisms and present the results in the form of good sketches.

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