INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	EXPERIMENTAL AERODYNAMICS
Course Code	:	R15-A72120
Class	:	IV B. Tech I Semester
Branch	:	AERO
Year	:	2018 – 2019
Course Coordinator	:	Mr. Shiva Prasad U, Assistant Professor, Dept of Aeronautical Engineering
Course Faculty	:	Mr. Shiva Prasad U, Assistant Professor, Dept of Aeronautical Engineering

COURSE OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

SNo	Question	Blooms taxonomy level	Course Outcomes
	UNIT– I **HISTORY, MODEL TESTING & TYPES OF AERODYNAMIC EXPERIMENTS**		
	Part – A(Short Answer Questions)		
1	Define the main objectives of aerodynamic experiments?	Remember	1
2	Explain the procedure of selecting model for aerodynamic observations?	Understand	1
3	Explain Classify various types of wind tunnel used for Aerodynamic studies.	Understand	1
4	What are the basic principles for wind tunnel selection?	Understand	1
5	What do you mean by scaling in model evaluation?	Understand	1
6	What is a transonic wind tunnel, what speeds we can achieve using this tunnel?	Remember	2
7	What are the scaling parameters, why it is important?	Remember	2
8	Explain the term dynamic similarity and what is it need.	Remember	3
9	Define laminar and turbulent flow with respect to Reynolds number	Remember	2
10	Gives the different forms of aerodynamic experiments?	Remember	2

	Part - B (Long Answer Questions)		
1	Write the significance of aerodynamic experiments in comparison to numerical analysis and theoretical solution.	Remember	1
2	Briefly describe the method of observation for aerodynamic experiments?	Understand	1
3	Discuss the scaling laws used in aerodynamic modelling of a model and what is the importance of similarity terms.	Understand	2
4	Write the importance of scale down model and it's relation to prototype.	Remember	2
5	Explain Buckingham pi theorem with example and define the dimensionless numbers used in experimental aerodynamics.	Understand	2
6	Suggest the methodology on model design and related precaution need to be taken while analysing the model.	Remember	2
7	Write the parameters used on scaling law. Explain about geometrical similarities.	Understand	3
8	What are the significance of similarity parameters? Explain any one parameter and its relation with experimentation.	Understand	3
9	Suggest some outcome from aerodynamic testing in relation to design of airplane model testing at various Reynolds numbers.	Understand	2
10	What are the essential conditions to be satisfied for the results to be carried from the model to the prototype? Are there any limitations or preconditions involved?	Remember	3
Part - C (Problem Solving and Critical Thinking Questions)			
1	Explain the Buckingham's Pi Theorem.	Remember	1
2	Briefly discuss the scale effects of similarities.	Understand	1
3	Discuss the classification of wind tunnels in detail.	Understand	2
4	Write the history of wind tunnel.	Remember	2
5	Explain the dynamic similarity between a wind tunnel model and the prototype to be flight-tested. What are the essential conditions to be satisfied for the results to be carried from the model to the prototype? Are there any Limitations or preconditions involved?	Remember	2
6	State Buckingham theorem. How is thus theorem use full in the experiments using wind tunnels?	Understand	2
7	Define the following non-dimensional numbers: force coefficient, Euler number, and Reynolds's number and moment coefficient. How do the model scale effects influence the wind tunnel test results?	Remember	3
8	Compare the geometrical and dynamic similarities. Find out the relation between geometrical parameters on dynamic similarity.	Understand	2
9	Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust depends on the angular velocity, speed of advance, diameter dynamic viscosity, mass density, and elasticity of the fluid medium which can be denoted by the speed of sound in the medium?	Understand	3
10	Briefly explain the types of non dimensionless numbers and give its importance with an example.	Remember	1
UNIT-II **DESIIGN OF LOW SPEED WIND TUNNEL**			
Part – A (Short Answer Questions)			
1	What is function of diffuser in a wind tunnel?	Remember	2

2	What is function of effuse/contraction in wind tunnel design?	Remember	2
3	What is breather in a low speed wind tunnel?	Understand	2
4	What are the merits and demerits of open circuit wind tunnel?	Remember	2
5	Define Energy Ratio and define the efficiency of a wind tunnel.	Remember	3
6	Define full wave rectifier why it is needed?	Remember	3
7	What are sources of inaccuracies in wind tunnel how to rectify it?	Understand	3
8	What is solid blockage what happens if it not considered?	Understand	4
9	What is wake blockage, how wake is formed in a tunnel?	Remember	4
10	What is meant by zero lift drag, does it have lift or not?	Remember	4
11	What are the causes of streamline curvature?	Remember	5
Part - B (Long Answer Questions)			
1	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.	Understand	2
2	What are the classifications of wind tunnel?	Remember	2
3	Discuss in detail the effect of flow quality in wind tunnel performance.	Understand	2
4	What are the components of low speed wind tunnel? Explain in detail any two of them.	Remember	3
5	What are the design requirements and constrictions in Low speed wind tunnels?	Understand	3
6	Discuss about the construction of Low speed wind tunnels. Explain in detail the loss coefficients in them.	Understand	3
7	Explain the purpose of the following: a) Diffuser b) straighteners, c) honeycombs, d) contraction cone and e) Turning vanes.	Remember	4
8	What is boundary layer correction in the test section design of wind tunnels?	Remember	4
9	With a neat illustration explain the objective of calibration of a wind tunnel. In what way the calibration procedure for a supersonic tunnel different from that of a subsonic wind tunnel?	Remember	4
10	Discuss the causes, estimation and correction of streamline curvature in a wind tunnel design.	Understand	5
11	Discuss in detail the wind tunnel corrections and the need for wind tunnel corrections.	Understand	6
12	Discuss in detail the corrections on airspeed and dynamic pressure in a low speed wind tunnel.	Understand	5
Part – C (Problem Solving and Critical Thinking)			
1	Explain the losses in low speed subsonic wind tunnel and supersonic wind tunnel during the test of a model.	Remember	3
2	Derive the equation for test section speed in low speedwind tunnel and draw the corresponding curve.	Understand	3
3	Explain the operation, merits, demerits and application of any three special purpose wind tunnels.	Understand	4

4	Describe the factors on which the pressure loss in a constant area cross section duct depend on?	Remember	4
5	Illustrate the factors on which the pressure loss in a diffuser depend on? Explain it qualitatively.	Understand	4
6	Explain it qualitatively the factors on which the pressure loss in a Honeycomb & screens depend on?.	Understand	5
7	ON what factors does pressure loss in a corner turning vanes depend on? Explain it qualitatively.	Understand	6
8	Why a drive system is required in a wind tunnel? Why Can't the wind tunnel have a sustained flow with just a convergent- test section- diffuser arrangement?	Remember	5
9	Is it not feasible to have a constant area test section with a fan at the exit? Why the present day convergent-constant area- diffuser configuration has evolved?	Understand	6
10	Distinguish constructional differences of at least five test sections based on their purpose?	Remember	6

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UNIT-III
HIGH SPEED TUNNELS AND LOW SPEED WIND TUNNEL BALANCE

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Part - A(Short Answer Questions)

1	What do you mean by a transonic wind tunnel?	Remember	7
2	What is a Supersonic wind tunnel testing speed range?	Understand	7
3	What is hypersonic wind tunnel at what speeds it can be used?	Understand	7
4	What is a blow down wind tunnel, how it is different from other type?	Understand	7
5	What are in draft wind tunnels, what are its applications?	Understand	8
6	What are the advantages of Blow down type wind tunnels?	Understand	9
7	What is a shock tube? How energy varies along it.	Remember	9
8	What is a shock tunnel and what are its applications.	Remember	8
9	What are the disadvantages of Blow down type wind tunnels?	Understand	8
10	What are the classifications of wind tunnel?	Remember	8
11	What are the types of loads occurring on a model in wind tunnel?	Understand	9
12	What is meant by wind tunnel balance and what are its types?	Understand	9
13	Describe wind tunnel balance and forces of evaluation.	Remember	7
14	Why do we need load measurements in a wind tunnel?	Understand	8
15	What are the types of wind tunnel balances, what forces does it measure?	Remember	9

Part – B (Long Answer Questions)

1	Sketch the typical layout of a supersonic wind tunnel and mark all the components and subsystems. What is starting problem in supersonic tunnels?	Understand	9
2	What is meant by subsonic and transonic speed regime, and detail the importance of method of characteristics?	Remember	9
3	What are the losses in supersonic tunnel, how to reduce the losses in a supersonic wind tunnel?	Remember	8
4	Compare the difference between subsonic, supersonic and hypersonic wind tunnel with respect to construction and testing with sketches.	Understand	8

5	Explain six component balance strain gauge basic principle with the basic principle and working with neat sketch?	Remember	8
6	Mention the features and characteristics of wind tunnelBalance and data acquisition system?	Understand	9
7	Distinguish between internal and external wind tunnel balances with neat illustrations and sketches?	Understand	9
8	Briefly explain how force measurements are carried out using an external strain gauge balance?	Remember	9
9	Bring out the essential features of a strain gauge basedSix-component internal wind tunnel balance?	Remember	10
10	Explain how the six components are calibrated using the balance?	Understand	10
Part – C (Problem Solving and Critical Thinking)			
1	Explain the operation, merits, demerits and application ofsupersonic and aero acoustic tunnel?	Remember	8
2	Briefly explain the special purpose hypersonic windTunnel, what are the basic requirements of hypersonic wind tunnel?	Understand	9
3	Explain with the aid of neat sketches the operation Gun tunnel and Shock tunnel?	Remember	9
4	With a neat illustration explain the objective of calibration of a wind tunnel. In what way the calibration procedure for a supersonic tunnel different from that of a subsonic wind tunnel?	Understand	9
5	What types of wind tunnel balances are used to ascertain forces and moments on an airplane model in a low speed wind tunnel?	Understand	10
6	Describe the underlying principles of an external type wind tunnel balance for measuring lift, drag and pitching moments over a finite span wing?	Remember	10
7	How are wind tunnel balances classified? Explain the types of wind tunnels based on the speed.	Remember	11
8	Explain wire type balance with neat sketch and mentionthe merits and demerits?	Remember	12
9	Explain the functioning of shock tube and parameters that dictate thestagnation condition?	Understand	12
10	Explain the purpose of heater in the settling chamber and second throat in the supersonic wind tunnel?	Remember	12
UNIT-IV **PRESSURE, VELOCITY & TEMPERATURE MEASUREMENT**			
Part – A (Short Answer Questions)			
1	What is meant by Liquid Doppler Anemometry?	Remember	13
2	What is meant by Particle Image Velocitymetry?	Remember	14
3	What is hot wire anemometry how is useful in model testing?	Remember	14
4	What is data processing in a wind tunnel experiments?	Remember	10
5	How pressure sensitive paints work over the model?	Understand	10
6	Name few equipment to measure velocity in a wind tunnel testing	Remember	11
7	Name few equipment to measure pressure in open circuit wind tunnel.	Remember	12
8	Name few equipment to measure Temperature variation.	Remember	12

9	How are the surface streamlines measured in wind tunnels?	Understand	15
10	How are the turbulence measured in wind tunnels?	Understand	15
Part – B (Long Answer Questions)			
1	Describe the basis for the measurement of pressure and Instruments used for the purpose. What are its advantages and applications? Illustrate with theory and example.	Remember	13
2	Explain how the surface streamlines measured in wind tunnels?	Understand	14
3	Explain Turbulence intensity measurements in wind-tunnel test section?	Remember	14
4	Explain how to measure velocity of flow using LDA technique?	Understand	10
5	What is the basic principle behind hot wire anemometer? What are its limitations?	Remember	10
6	Explain with a neat sketch the working of a hot wire anemometer?	Understand	11
7	Describe Particle Image Velocimetry and explain its working principle?	Understand	12
8	Describe the experimental setup, calibration and measurement in Particle Image Velocimetry?	Remember	12
9	Describe various pressure transducers and their concepts underlying their measurement?	Understand	15
10	Describe Pressure sensitive paints and their applications in analysing the model?	Remember	15
Part – C (Problem Solving and Critical Thinking)			
1	What is meant by LDA? How is velocity measured of flow using LDA technique?	Remember	13
2	What is meant by PIV? What are its limitations? Explain the working principle of PIV?	Understand	14
3	What are the important assumptions in the principle of operation of hot wire anemometry, thus limitations of this technique? Why l/d of the hot wire probe very large?	Remember	14
4	What is the basic principle behind hot wire anemometer? What are its limitations? Explain with a neat sketch the working of a hot wire anemometer?	Understand	10
5	Why are hot wire anemometers preferred for measurement in the low velocity regimes? How are the two modes of hot wire anemometry different from each other?	Understand	10
6	Explain the techniques used for Turbulence measurements in a wind tunnel?	Remember	11
7	Write notes on: (a) setting Mach number in a transonic wind tunnel (b) Measurements of turbulence in tunnel. Explain the techniques used for turbulence measurements in a wind tunnel. level in a transonic wind	Remember	12
8	What is the purpose served by the seeding particles in LDA measurements? Derive the classical equation connecting the velocity and the Doppler frequency?	Remember	15
9	Why is the photo receiver in LDA system kept at small angle to the direction of the incident beam? Differentiate between the backward and forward scattering modes of LDA?	Understand	15

10	What component in LDA systems help determining the direction of the flow? What is understood by the fringe model of LDA?	Remember	15
11	What are the advantages of laser Doppler anemometry for velocity measurements? Compare and contrast LDA with hotwire anemometry?	Remember	15
12	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. It is desired to obtain pressure distribution of a rotating circular cylinder kept in the test section of a wind tunnel?	Understand	14
	UNIT-V **FLOW VISUALIZATION**		
Part - A (Short Answer Questions)			
1	Explain the classification of flow visualization Techniques?	Understand	14
2	What are optical flow visualization techniques?	Remember	13
3	What is surface flow visualization oil spray technique?	Understand	12
4	What is data flow visualization techniques for wind tunnel testing?	Remember	13
5	What are hydrogen bubble and smoke visualization techniques?	Understand	14
6	What is the technique adopted to visualize Shock waves?	Understand	13
7	What is china clay visualization, how does it works?	Remember	14
8	What are tufts? How are mini tufts better than tufts?	Remember	13
9	Draw a schematic of the schlieren system making use of concave mirrors marking the components and the test section	Understand	15
10	What is Shadowgraph technique and write its basic principle.	Remember	15
11	Why the bow shock visualized through shadowgraph has bright and dark bands?	Understand	Q5
Part - B (Long Answer Questions)			
1	Explain the classification of flow visualization techniques in a wind tunnel experimental model testing?	Understand	14
2	Explain the optical flow visualization techniques are utilized in testing what are it demerits?	Understand	13
3	Explain surface flow visualization technique, explain whether it can be used at high speeds or not?	Remember	12
4	Explain the data flow visualization techniques adopted in wind tunnel measurements can we adopt same techniques at all speeds?	Understand	13
5	Describe various flow field visualization techniques in a wind tunnel model testing at subsonic speeds?	Remember	14
6	Discuss the smoke and tuft grid Visualization techniques used for flow automobile applications?	Understand	13
7	Explain in detail schilerin technique with basic principles and illustrate with neat sketch?	Understand	14
8	Explain in detail shadowgraph technique with the aid of a sketch and label the parts?	Remember	15
9	How are the imagery of schlieren and shadowgraph different in interpretation discuss with a neat sketch?	Remember	15
10	Explain the interferometry principle with neat sketches explain its procedure to be adopted for testing in a wind tunnel.	Remember	15

	Part – C (Problem Solving and Critical Thinking)		
1	What are the requirements of tracer particles used for flow visualization? Why tracer methods cannot be used for visualization of compressible flows?	Remember	13
2	What are the advantages of flow visualization methods using at low and high speed flows? What is the basic principle involved in the interferometer method of flow visualization?	Understand	13
3	What is the basic principle involved in the dye injection Method of flow visualization? What are the limitations of dye injection method for flow visualization?	Remember	14
4	What is the need of flow visualization techniques? Briefly explain the optical methods used for flow visualization	Understand	14
5	With neat illustration explain the basic principles of Schelieren method of flow visualization. What are the advantages and limitations of the method??	Understand	14
6	Explain the phenomenon of separation of flow over a 2D wing with the help of liquid paraffin generated smoke wire technique with good sketches. What are its merits over kerosene generated smoke?	Remember	13
7	On what factors does the sensitivity of interferometer depend, explain in detail with the aid of sketches?	Remember	12
8	Why the lenses/mirrors used in schlieren system has large focal length?	Remember	14
9	What is Gladstone-Dale equation? How does it explain the deflection of a lightRay in a compressible medium?	Understand	15
10	Differentiate the three optical methods schlieren, shadowgraph and interferometry and their relative advantage over each other.	Remember	15

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