INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

ASSIGNMENT QUESTIONS

Course Name	:	**COMPUTATIONALAERODYNAMICS**
Course Code	:	A62114
Class	:	III B. Tech II Semester
Branch	:	Aeronautical Engineering
Year	:	2017 – 2018
Course Coordinator	:	Dr. G Malaikhannan, Professor, Department of Aeronautical Engineering
Course Faculty	:	Mr. G Satya Dileep, Assistant Professor, Department of Aeronautical Engineering

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.

S. No	Question	Blooms Taxonomy Level	Course Outcome
	ASSIGNMENT-I **UNIT-I** **BASIC ASPECTS OF COMPUTATIONAL AERODYNAMICS**		
1	a) Discuss with a neat diagram shock capturing method along with its merits and demerits b) Explain why conservation form of governing equations is important for calculations using shock capturing method.	Understand	1,2
2	Explain how the continuity equation derived from these flow models can be converted from conservative to non conservative form.	Remember	1,2
3	a) Derive continuity equation in non-conservation form using suitable model b) Derive the energy equation in only internal energy form.	Understand	1,2
4	a) Derive energy equation in conservation form using infinitesimal small fluid element moving in space for compressible viscous flow b) Discuss the physical boundary conditions for a viscous flow	Understand	1,2
5	Explain and Differentiate shock fitting and shock capturing methods.	Remember	1,2
	UNIT-II **MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND THEIR IMPACT ON COMPUTATIONAL AERODYNAMICS**		
1	Classify the following set of equations for irrotational, two-dimensional, in viscid, steady flow of a compressible flow using Eigen value method: $(1 - M_\infty^2)(\partial u'/\partial x) + (\partial v'/\partial y) = 0$ $(\partial u'/\partial y) - (\partial v'/\partial x) = 0$ Where u', v' are small perturbation velocities measured relative to the free Stream velocity.	Understand	3,4
2	What is a region of influence and its importance in CFD?	Remember	3,4
3	How will be the mathematical behavior of various types of partial differential Equations?	Understand	3,4

S. No	Question	Blooms Taxonomy Level	Course Outcome
4	Explain the classification of the following quasi-linear partial differential equations using Cramer’s rule: $a_1 (\partial u/\partial x) + b_1 (\partial u/\partial y) + c_1 (\partial v/\partial x) + d_1 (\partial v/\partial y) = f_1$ $a_2 (\partial u/\partial x) + b_2 (\partial u/\partial y) + c_2 (\partial v/\partial x) + d_2 (\partial v/\partial y) = f_2$ Where u and v are dependent variables, continuous functions of x and y and a_1, a2, b_1, b_2, c_1, c_2, d_1, d_2, f_1, f_2 can be functions of x, y, u and v.	Understand	3,4
5	Discuss the physical behavior of flows governed by parabolic equations with an example of steady boundary layer flows. Explain PNS model for high speed flows and explain its merits.	Remember	3,4
	UNIT-III **BASIC ASPECTS OF DISCRETIZATION**		
1	Write short notes on the following properties of numerical solutions of fluid flows: i) Stability ii) Consistency iii) Accuracy iv) Convergence.	Remember	5,6
2	Explain Von Newmann stability analysis with an example.	Understand	5,6
3	Write down the formulation of central difference scheme for u velocity in the x direction. What is the truncation error in terms of Δx and state the order of this discretization scheme?	Understand	5,6
	ASSIGNMENT – II **UNIT-III** **GRID GENERATION**		
4	Explain C-H, H-O-H, O-H grid topologies with sketches along with their applications	Remember	5,6
5	Define structured and unstructured grids. Discuss various configurations of, Body-fitted structured grids and multi-block grids with the help of sketches.	Understand	5,6
	UNIT-IV **FINITE VOLUME METHODS**		
1	Explain cell-centered and cell-vertex discretization methodologies used in Finite volume approach with the help of sketches. What are the constraints to be satisfied on the choice of discretized control volumes for a consistent finite volume method?	Understand	7
2	Explain the reasons that make finite volume method superior to other Discretization methods in CFD. Discuss the cell-centered and cell-vertex approaches to finite volume discretization using sketches.	Remember	7
3	Define finite volume discretization and explain the features which distinguish the interpretation of finite volume methods from the finite difference approach	Understand	7,8
4	Discuss the general formulation of a numerical scheme based on finite volume method.	Remember	8
5	Explain the two-dimensional finite volume method and describe evaluation of fluxes through cell surfaces using central discretization schemes	Remember	8
	UNIT-V **CFD TECHNIQUES**		
1	Explain explicit Mac Cormack Technique for a steady, two-dimensional, supersonic, in viscid flow field in (x,y) space using the following generic conservation form without source terms: $\partial F/\partial x = - \partial G/\partial y$ where F and G represent flux vectors formed from the governing equations.	Understand	9,10
2	Discuss ADI method for solving parabolic problems.	Understand	9,10
3	Explain checker-board behavior of velocity and pressure fields in central discretization schemes using sketches and explain how such behavior can be avoided.	Understand	9,10
4	Describe the SIMPLE algorithm step by step for estimation of velocity and Pressure fields in solving incompressible viscous flow problems.	Understand	9,10
5	Explain Crank-Nicolson implicit scheme used for solving the parabolic partial differential equations.	Understand	9,10

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