**Rajalakshmi Engineering College, Chennai**

**Department of Aeronautical Engineering**

**AE 2402 - Computational Fluid Dynamics: Question Bank**

**PART – A**

1. What are the important applications of CFD in engineering?
2. Distinguish between conservation and non-conservation forms of fluid flow.
3. Write down conservative form of continuity equation and explain the terms involved.
4. List out advantages of panel method.
5. Explain the difficulties of evaluating the influences of a panel at its own control point.
6. Elaborate the basic aspects of finite difference equations.
7. Define stability.
8. Differentiate between structured and unstructured grid.
9. Write down the significance of Taylor series expansion.
10. Write down the second order central mixed finite difference expression for 
11. List out differences between finite volume and finite difference methods.
12. What is the necessity for strong and weak formulations of boundary value problem?
13. What is meant by CFL condition?
14. Differentiate between surface fitted and body fitted coordinate systems.
15. Write down an expression for the substantial derivative in Cartesian coordinates.
16. Define convergence.
17. Define discretization and round off error.
18. Explain cell-centered method.
19. What is the need for staggered grid?
20. What types of grids are used in FVM?
21. Discuss the need for upwind type discretization.
22. What are the methods available for grid generation?

**PART – B**

1. Derive the energy equation for a viscous flow in partial differential non-conservation form.
2. Derive the continuity equation for inviscid flow in partial differential non-conservation form.
3. Write down elliptic, parabolic and hyperbolic partial differential equations as applicable to CFD.
4. Explain the grid generation technique based on PDE and summarize the advantages of the elliptic grid generation method.
5. Obtain the 2D steady compressible continuity equation in transformed coordinates for the transformation.
6. Write down the procedure for the calculation of pressure coefficient distribution around a circular cylinder using the source panel technique.
7. Discuss the vortex panel method applied to lifting flows over a flat plate.
8. Discuss the source panel method for the flow past an oscillating cylinder.
9. State and explain the difference between explicit and implicit methods with suitable examples.
10. How do you determine the accuracy of the discretization process? What are the uses and difficulties of approximating the derivatives with higher order finite difference schemes? How do you overcome these difficulties?
11. Explain the strong and weak formulations of a boundary value problem.
12. Explain the description of Prandtl boundary layer equation and its solution methodology.
13. Study the stability behaviour of second order wave equation by Von-Neuman stability method.
14. What are quadrilateral Lagrange elements and isoparametric elements in FEM?
15. Solve the simplified Sturn-Lioville equation:

 With boundary conditions y(0) = 0 and ; using Galerkin finite element method.

1. What is strong formulation? Explain with the help of one dimensional boundary value problem.
2. Explain Runge-Kutta and multi-stage time stepping.
3. Discuss the properties of discretization schemes and explain upwind discretization applied to FVM.
4. What is cell centered formulation? Explain with the help of using control volume, semi discretization equation, 
5. State and explain the spurious modes for Runge-Kutta cell vertex formulation in FVM.