M. M E. 1st Semester Examination, 2018 EX/PG/ME/T/113C/2018

TURBULENCE

Time :- Three Hours Full Marks :- 100

Answer two questions from each group

GROUP A

1. a) Define a turbulent flow and the intensity of turbulence. What is isotropic and anisotropic turbulence? In a circular pipe flow draw the entrance length and the fully developed velocity distributions for a laminar and turbulent flow in different sketch. Why the entrance length of turbulent flow is less than that of laminar flow? (3+3+1+1+3+3+1=15)
   b) Explain the method of analysis of a turbulent flow. (10)

2. (a) What do you understand by correlation function in turbulence? Explain Integral, Kolmogorov and Taylor length, velocity and time scales. 'It is the Vortices that is always present in a real flow, whether it is laminar or Turbulent flow', explain. (15)
   (b) Explain Kolmogorov first and second hypothesis in connection with the Turbulence. (10)

3. a) What is ***ENERGY CASCADING***? With a diagram explain thoroughly. What do you understand by ***BACK SCATTERING***? Explain with a pictorial diagram. (15)
   b) Explain vortex stretching with a diagram. (10)

4. a) Explain the origin of turbulence. Draw a turbulent boundary layer over a flat Plate and show the laminar sub-layer. (15)
   b) Explain Kolmogorov's Energy spectrum diagram in details. What is wave number? How it is related with dissipation rate? (10)

GROUP-B

1. Explain Prandtl's mixing length theory. (25)

2. Deduce Prandtl's Universal Velocity Distribution Equation and Von-Karman Logarithmic law of the wall. (25)

3. Deduce the RANS equation and indicate the Reynolds Stress? (25)

4. Deduce $K - \varepsilon$ equation. (25)