B.E. MECHANICAL ENGINEERING FOURTH YEAR FIRST SEMESTER – 2024

Ref. No. : Ex/ME(M2)/PE/H/T/414G/2024

INTRODUCTION TO TURBULENT FLUID FLOW (Hons.)

Time:-Three Hours Full Marks:-100

Answer any **five** Questions

Assume any data relevant to the questions if not provided

1. a) Show analytically that Turbulent Flow is always **three dimensional (3-D).** Show that both mean and fluctuating components of velocity follow continuity equation. (05+05=10)

   b) Explain **Large Eddies, Smallest** and **Intermediate** eddies **Eddies**? How they are related in the generation or demolition processes of the turbulence? (03+03=06)

   c) Why smallest eddies are called universal in nature? (04)

2. a) Explain the effects of **Diffusion** on the turbulence phenomena. (05)

   b) What is **Vortex Stretching**? Explain in details and give an example. (15)

3. a) Explain with diagrams how turbulence is originated. (10)

   b) Explain Energy Cascading in Turbulence. (10)

4. Derive the Reynolds averaged Navier-Stokes equation for an Incompressible unsteady turbulent 3-D flow in rectangular co-ordinate system. (20)

5. Explain Prandtl's Mixing Length theory for a 2-D incompressible and steady Turbulent flow and obtain the expression for the Mixing Length. (20)

6. Write short note on any Four. (4 x 5 =20)

a) Auto Correlation

b) Isotropic and An-isotropic Turbulence

c) Reynolds Stresses

d) Laminar Sublayer

e) Integral scales and Kolmogorav scales.

7. Explain in details the characteristics of turbulence. (20)