

**BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)
FIFTH YEAR SECOND SEMESTER EXAM - 2025**

Ref. No.:Ex/ME/5/T/524C/2025

INTRODUCTION TO TURBULENCE

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)**. (10)
b) What do you understand by the terms **Large Eddies** and **Smallest Eddies**? Explain the origin of turbulence. (02+08=10)
2. a) Explain isotropic and an-isotropic turbulence. (05)
b) Explain in details the characteristics of turbulence. (15)
3. a) What do you understand by Energy Cascading in Turbulence? Explain in details. (10)
b) Explain Boussinesq's theory related to turbulence. (10)
4. Derive the Reynolds averaged Navier-Stokes equation for an Incompressible unsteady turbulent 3-D flow in rectangular co-ordinate system. (20)

[Turn over

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. Find the universal velocity distribution over a flat plate. (20)
7. Write short note on any Four. (4 x 5 =20)
 - a) Length, time and velocity scales in turbulence
 - b) Turbulence Intensity
 - c) Reynolds Stresses
 - d) Laminar Sublayer
 - e) Wall Function in $k - \varepsilon$ model.