National University of Sciences and Technology

Course Description

Course Title	Course Code	Credit Hours
Turbulence Modelling in Fluid Mechanics with AI	ME-877	3 – 0

Textbook:

- Turbulence Modeling for CFD" by David C. Wilcox

Course Books:

- Large Eddy Simulation for Incompressible Flows: An Introduction" by Pierre Sagaut
- Artificial Intelligence in Fluid Mechanics" by Arash Komaee and Mohammad Faghri

Course Objective:

- The aim of the course is to understand the fundamentals of turbulence and its importance in fluid mechanics and to learn about different turbulence modelling techniques and their strengths and Limitations

Course Outline:

- Introduction to Turbulence, Characteristics of turbulent flow, Importance of turbulence in fluid mechanics, Overview of turbulence modelling techniques
- Reynolds-Averaged Navier-Stokes (RANS) Equations, Derivation and assumptions, Limitations of RANS equations, Popular RANS models (e.g., k-epsilon, k-omega, SST)
- Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS), Overview of LES and DNS, Comparison with RANS models, Advantages and limitations of LES and DNS
- Introduction to Machine Learning and Artificial Intelligence, Basic principles of machine learning and artificial intelligence, Supervised and unsupervised learning, Neural networks and deep learning
- Application of Machine Learning and Artificial Intelligence to Fluid Mechanics, Overview of applications in fluid mechanics, Turbulence modelling with machine learning and artificial intelligence, Examples of successful applications
- Practical Experience with Machine Learning and Artificial Intelligence for Turbulence Modelling
- Hands-on exercises using machine learning and artificial intelligence tools, (e.g., TensorFlow)
- Developing and validating a turbulence model using machine learning and artificial intelligence
- Application of the developed model to solve practical engineering problems

ASSESSMENTS

Description	Percentage Weightage (%)
Assignments	05-10%
Quizzes	10-15%
Mid Semester Exams	30-40%
End Semester Exam	40-50%