Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2019-2020

Course Handout Part II

Date: 15/07/2019

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : ME G621
Course Title : Fluid Dynamics
Instructor-in-Charge : K. Ram Chandra Murthy

Scope and Objective of the Course:

The objective of this course is to lay strong foundation in understanding the concepts on turbulence and the statistical and computational methods used in estimating it. Starting from the basics of laminar flow concepts, the key parameters of turbulence is explained with the help of equations of motion. This course focuses also on fundamentals of compressible flow viz isentropic flow, shock waves, Prandtl-Meyer expansions. The fundamental mathematics and physics governing these flows are derived and discussed.

Text Book (TB):

1. Garde R. J., *Turbulent Flow*, New Age International Pvt. Ltd., New Delhi, 3rd Ed., 2010.
2. Yahya S. M., *Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion*, New Age International Pvt. Ltd., New Delhi, 4th Ed., 2010.

Reference Book (RB):

1. John D. Anderson Jr., *Modern Compressible Flow - With Historical Perspective*, McGraw-Hill Publishing Company, Singapore, 2nd Ed., 1990.
2. Stephen B. Pope, *Turbulent Flows*, Cambridge University Press, 2000.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter/ Section
1-4	Laminar Flow	Introduction, Equations of motion, Conditions of Similarity, Creeping motion, Exact solutions of N-S equations, Boundary layer approximations, Characteristics of laminar flows	TB:1 Chapter: 1
5-7	Transition from Laminar to Turbulent Flow	Concept of Stability, Stability analysis, Experimental verification, Factors affecting transition	TB:1 Chapter: 2
8-11	Nature of Turbulence	Averaging procedures, Characteristics of turbulent flows, Types of turbulent flows, Scales of turbulence, Methods of analysis	TB:1 Chapter: 3
12-14	Equations of Motion	Reynold's equation of motion, Energy Equation, Bernoulli's equation for mean flow	TB:1 Chapter: 4

15-20	Statistical Theory of Turbulence	Introduction & some definitions, Isotropic turbulence and homogeneous turbulence, Kinematics & dynamics of isotropic turbulence, Spectrum analysis, Kolmogorov's theory of local isotropy	TB:1 Chapter: 5
21-24	Turbulence Models	Mixing length hypothesis, Karman's similarity hypothesis, Vorticity transport theory, Zero equation models, One equation models, Two equation models, Multi-equation models	TB:1 Chapter: 6
25-27	Introduction to Compressible flow	Definitions, Basic relations, Energy equations	TB:2 Chapters: 1&2
28-29	Rate Equations	Rate equations for a control volume	TB:2 Chapter: 3
30-32	Isentropic Flow with Variable Area	Stagnation and critical states, Flow through nozzles and diffusers, Use of gas tables	TB:2 Chapter: 4
33-36	Flow with Normal Shock Waves	Governing equations, Prandtl-Meyer Relation, Rankine-Hugoniot equations, Strength of a shock wave, Moving normal shock waves	TB:2 Chapter: 6
37-39	Flow in Constant Area Ducts with Friction	Fanno curves, Fanno flow equations and their solutions, Variation of Mach number with duct length, Isothermal flow with friction	TB:2 Chapter: 8
40-42	Flow in Constant Area Ducts with Heat Transfer	Rayleigh line, Rayleigh flow relations, Maximum heat transfer	TB:2 Chapter: 9

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Assignments	-	10	To be announced in the class	Open Book
Lab Reports & Viva	-	15	To be announced in the class	Open Book
Project Seminars (Mid- & End-sem)	-	20	To be announced in the class	Open Book
Midsem Test	90	20	03/10 , 11:00 – 12:30 pm	Closed Book
Compre	180	35	09/12 AN	Closed Book

***List of Experiments:**

1. Free and forced vortex flow
2. Reynold's and laminar flow
3. Boundary layer flow
4. Nozzle performance test
5. Nozzle pressure distribution test

Chamber Consultation Hour: To be announced in the class.

Notices: All notices concerning this course will be displayed in *CMS (institute's web-based Course Management System)*. S tudents are advised to visit *CMS* regularly for all notices and updates.

Make-up Policy: Make-up request for tests shall be granted only for the *genuine* case with sufficient evidence. Request letter duly signed by the student must reach the undersigned at least one day before the scheduled test.

Academic Integrity Policy: It is expected that in compliance with institute rules and regulations, academic integrity should be adhered to in all the evaluation components. No type of academic dishonesty is acceptable and malpractice in any form will have serious implications.

INSTRUCTOR-IN-CHARGE (ME G621)