Your Roll Number: P-2109

Internal Exam

DEPARTMENT OF MATHEMATICS, UNIVERSITY OF DELHI
M.Phil./PhD Coursework Examinations, June.2022

MATH21-R08: HYPERBOLIC SYSTEM OF CONSERVATION LAWS AND BOUNDARY LAYER THEORY

Time: 1.5 hours | Maximum Marks: 30

Instructions: • Question no. **1** is compulsory. Attempt **5** questions in all. • Answer ANY **4** questions from section B. • All the symbols have their usual meaning.

Section A

(Answer all the parts)

(1) (a) Show that the dimensionless boundary layer thickness for a laminar flow of a viscous fluid over a flat plate of length l is inversely proportional to the square root of Reynolds number. [2 Marks]

(b) Describe the different mode of heat transfer with necessary equations. [3 Marks]

(c) Show that shearing stress near the wall is proportional to the $U^{\frac{3}{2}}$, where U is uniform speed. [2 Marks]

(d) If temperature T and pressure p of a perfect gas deviate from their reference values T_∞ and p_∞, then calculate the deviation in density ρ of the gas. [3 Marks]

Section B

(Answer any FOUR questions)

(2) Write the Prandtl's boundary layer equations along with the boundary conditions for two dimensional viscous incompressible fluid flow over a slender body. Write the equations in term of stream function. [5 Marks]

(3) Define mass and momentum thickness of a boundary layer and derive their expression. [5 Marks]

(4) Derive the ratio of inertial force and viscous force per unit volume for steady viscous flow of an incompressible fluid and compare them in term of Reynolds number. [5 Marks]

(5) Derive relation between Eckert's number and Mach Number. Describe Nusselt number. [3+2 Marks]

(6) Define the adiabatic temperature increase. Prove that temperature increase through adiabatic compression is proportional to the square of free stream velocity. [5 Marks]

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