**B. K. (Mcch.) Part-II 4" Semester Final Examination, 2010**

29.5

**Mechanics of Fluid - II (AM 404)**

**Time: 3 His.** **Full Marks: 70**

**I 'sc separate answer scripts for each half**
**Answer six questions taking three from each half**
**All questions are of equal value**
**I wo marks are reserved for neatness in each half**

**FIRST HALF**

**Derive the expressions for stresses $x_{..}$ and $x«>$ in cylindrical coordinate system.**

**Derive the equation of the principle of the conservation of linear momentum for an incompressiMtf laminar How in the r-direetion in cylindrical co-ordinate s\Mem. Slate and apph all the assumptions required.**

**al Derive the expression of Much numbers across a normal shock.**

**hi W hai is the relation between stagnation density across a normal shock?**

**ct Derive the expression for ftayleigh Pilot tube formula.**

**Consider n Math 3 flow. \\ is desired to slow the flow to a subsonic speed. Consider two separate ways for achieving this: (1) the Mach 3 now is slowed by passing directly through a normal shock wave: (2) the Mach flow first deflected b\ *22"* through an oblique shock with a 40" wave angle, and then subsequently through a normal shock. Calculate the ratio of final total pressure values for the**

**Il> taking a third order velocity profile determine the displacement thickness, momentum thickness and coefficient of drag in terms of streamwise coordinate ami Reynolds number for a two dimensional, incompressible and laminar flow inei a Hal plate held parallel to the flow.**

Second Half

6A)F1OW takes place from **a** kvger diameter pipe to **a** smaller diameter pipe, which is ooaxklly fitted suffickiafy inside the larger pipe. Assuming the piusaure in dw annular am between the two pipe* **al** equal to the total pressure in the larger diameter pipe deduce an expnasioa for lew of bead due to neb a fitting in terra of crow sectional areaa of two ptpee and velocity in •mailer pipe.

b) A horizontal pipe, 100 nun in diameter, is joined by sudden enlargement to a 150 mm diameter pipe. Water is Rowing through it at the rate of 2 mVmmTind the loss of bead due to abrupt expansion and the pressure difference in the two pipes. If the change of section is gradual without any loss, what would be the change in pressure 7

7.a) A pipe of length X' and diameter'd' is fitted with a nozzle at its exit A constant head 'H* is maintained at the inlet to the pipe. Determine the noxzle tip diameter so that the power transmitted through the-pipe-oozzle assembly is a maximum.

b) Calculate the power required to pump sulphuric acid (viscosity 0.04 Ns/m$^{l}$ and specific gravity 1 .S3) at 45 lit/sec from **a** supply tank to **a** storage tank. The two tanks **are** connoctrri by **a** glass-lined pipe of 150 mm diameter and IS m length. The liquid level m the storage tank is 6 m above that in supply tank. Assume for turbulent flow in the pipe, f-0.0056(l+l00 N*$^{l}$") and for laminar flow f - 64/N». Neglect minor leases.

gjt) An oil flows from an open vessel at the rate of 1.7 cc/sec through a 450 mm long and 2.5 mm bore vertical tube. The oil surface in the vessel is 600 mm above the lower end of the tube. Neglecting the exit velocity and assuming fully developed laminar flow throughout the entire tube, determine- the Vunemanc viscosity of the oil

b) Two reservoirs. A and C, are connected through a 300 mm diameter pipeline 1 km long. At a point B in the pipeline, 300 mm from reservoir A, a valve is fitted on a abort branch pipe, laid in parallel to the main pipe, which discharges in to atmosphere. The valve may be considered as an orifice with Cj - 0.65. If me friction factor f for all pipes ii 0.03, calculate the rate of diecbargc to the reservoir C when the valve on the branch line at B is fully open. Also estimate the flow through the short pipe into atxnosphere

9 A nng main consists of **a** Quadrilateral network of pipes. ABCD and **a** triangular network of pipes ADE, the pipe AD being common to both networks. The reaiatances of the pipes AB. BC, CD, DA. AE and DE are 4. 2. 5,4, 2 and 3 unrts respectively. A flow of 10 units enters the entire network at E and flows of 3,4 and 3 units leave the network at B, C and D respectively. Estimate, by Hardy-Cross method, the flow rates in each pipe upto an accuracy 0.1 units of flow and indicate their directions on **a** sketch.

10. Write short notes on any three of the following:

(a) Water Hammer ; (b) Economic Pipe Diameter (c) Uminar Sub Layer (d) Mach Cone (e) Stokes law for flow around a sphere.