Department of Mechanical & Industrial Engineering

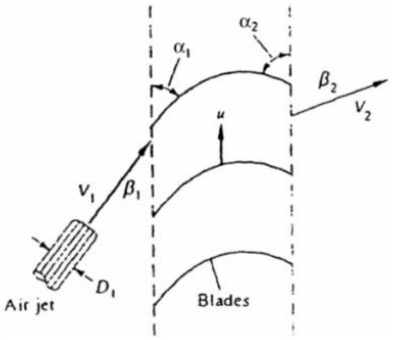
MIN-304 **Tutorial 1**

Fluid Machinery

(1) A uniform pipe 75 m long containing water is fitted with a plunger. The water is initially at rest. If the plunger is forced into the pipe in such a way that the water is accelerated uniformly to a velocity of 1.7 m/s in 1.4 seconds, what will be the increase of pressure on the face of the plunger assuming that the water and the pipe are not elastic?

If instead of being uniformly accelerated the plunger is driven by a crank 0.25 m long and making 120 rpm so that the plunger moves with simple harmonic motion, what would be the maximum pressure on the face of the piston?

(2) A fluid jet of diameter D1 enters a cascade of moving blades at absolute velocity V1 and angle β_1, and it leaves at absolute velocity V1 and angle β_2, as in figure. The blades move at velocity u. Derive a formula for the power P delivered to the blades as a function of these parameters



(3) A jet of water 50 mm in diameter with a velocity of 18 ms^{-1} strikes a flat plate inclined at an angle of 25° to the axis of the jet. Determine the normal force exerted on the plate *(a)* when the plate is stationary, *(b)* when the plate is moving at 4.5 ms^{-1} in the direction of the jet, and *(c)* determine the work done and the efficiency for case *(b)*.

(4) A jet of water delivers 85m^3s^{-1} at 36 ms^{-1} onto a series of vanes moving in the same direction as the jet at 18 ms^{-1}. If stationary, the water which enters tangentially would be diverted through an angle of 135°. Friction reduces the relative velocity at exit from the vanes to 0.80 of that at entrance. Determine the magnitude of the resultant force on the vanes and the efficiency of the arrangement. Assume no shock at entry.

(5) A 5 cm diameter jet delivering 56 liters of water per second impinges without shock on a series of vanes moving at 12 ms^{-1} in the same direction as the jet. The vanes are curved so that they would, if stationary, deflect the jet through an angle of 135°. Fluid resistance has the effect of reducing the relative velocity by 10 per cent as the water traverses the vanes. Determine *(a)* the magnitude and direction of the resultant force on the vanes, *(b)* the work done per second by the vanes and *(c)* the efficiency of the arrangement