Department of Mechanical Engineering, IIT Kharagpur

Applied Thermofluids-2 (ME40603/ME40701)

3rd Class Test (7th November 2017)

Max. Marks: **20**   Duration: **50 minutes**

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Make suitable assumptions, wherever necessary

1. Steam is supplied to a **50 MW**, single stage impulse turbine through **50 identical, convergent-divergent steam nozzles**. During the process, steam undergoes expansion from an initial condition of **114 bar** and **400°C** to a final pressure of **20 bar**. The enthalpy at the inlet and exit of the nozzle are: 3065 kJ/kg and 2689 kJ/kg, respectively. The specific volume of steam at the inlet to the nozzles is **0.0225 m³/kg**. The critical pressure ratio is **0.5457** and the expansion process in the nozzle follows the equation $pv^{1.3} = constant$; where p and v are absolute pressure and specific volume. Neglect velocity at the inlet to the nozzle and assume ideal conditions. From the given data find exit and throat diameters of the nozzle.   (10)

2. In an impulse turbine, the inlet fluid velocity and blade speed are **600 m/s** and **300 m/s**, respectively. The blades are symmetrical. If the area of the inlet and exit velocity triangles are **25000 m²/s²** and **24000 m²/s²**, respectively, find a) Inlet nozzle and blade angles, b) Power developed (in kW) for a mass flow rate of **24 kg/s**, c) Blade friction coefficient, d) Axial thrust (in N), and e) Turbine Utilization factor.   (10)

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