

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

V SEMESTER B.TECH (MECHANICAL ENGG) END SEMESTER **EXAMINATIONS. NOVEMBER 2017**

SUBJECT: TURBO MACHINES [MME 3101]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- ✤ Use of Thermodynamic data hand book is permitted
- **1A.** Obtain the expression for Euler turbine equation with the help of velocity 05 diagrams. Deduce the same to obtain as the sum of dynamic head and static heads.
- 1B. At a stage of an impulse turbine the mean blade diameter is 750mm, with a 05 rotational speed of 3500RPM. The absolute velocity of the fluid discharging from the nozzle inclined at 20° to the plane of the wheel is 275m/s. If the utilization factor is 90% and the relative velocity at exit is 0.9 times that at the inlet, find the inlet and exit blade angles, power output for a mass flow rate of 5kg/s and axial thrust.
- 2A. Derive an expression for utilization factor of a turbine in terms of absolute 05 velocities of the fluid and degree of reaction.
- 2B. The overall pressure ratio through a 3 stage gas turbine is 11 and the total to 05 total efficiency is 88%. The temperature at the inlet is 1500K. If the temperature drop in each stage is same, determine for each stage (i) pressure ratio, (ii) stage efficiency
- The impeller of a centrifugal pump has backward swept blades inclined at 30° 05 3A. to the tangent at impeller outlet. The blade width and the impeller diameter at the exit are 20mm and 250mm respectively. Speed is 1450RPM. The flow rate through the pump is 0.028m³/s and a slip factor of 0.77 may be assumed. Determine the theoretical head developed by the impeller and the number of impeller blades.
- With the help of velocity triangles, derive the expression for degree of 05 3B. reaction of an axial flow compressor in terms of inlet flow angle and exit blade angle.
- **4A.** A centrifugal compressor runs at 15,000 RPM and has radially tipped blades 05 with an outer tip diameter of 600 mm. The absolute velocity at compressor inlet is radial to ensure shock-less entry. The exit meridional component is

135 m/s. The stagnation conditions at inlet are 1 bar and 25°C. If the slip factor is 0.84, find (i) slip, (ii) number of impeller blades based on stodola theory, (iii) the actual exit blade angle and (iv) actual exit total temperature.

- 4B. Obtain the expression maximum utilization factor in a pelton turbine and 05 show that it is a function of exit blade angle and bucket loss coefficient only. Draw the velocity diagrams.
- 5A. An Inward flow reaction turbine develops 450 kW of power under a head of 60 m while running at 600 RPM. The ratio of outer to inner diameter of the runner is 2. The ratio of width to diameter at inlet is 0.12. The overall efficiency is 80%.and hydraulic efficiency is 85%. If the coefficient of velocity of flow is constant and equal to 0.15. Assuming radial discharge, Compute: (i) Runner diameter and width at inlet.
 - (ii) Guide blade angle at inlet.
 - (iii) Inlet and exit blade angle.
- **5B.** With the help of velocity triangles show that the utilization factor in a Curtis **05** two stage steam turbine is a function of blade speed ratio and inlet nozzle angle.