Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

V SEMESTER B. TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2018

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 Thermodynamics data hand book is permitted.

1A. The specifications for an axial flow coolant pump (uses cold water) for a pressurized nuclear reactor are: Head = 85m, Flow rate =20,000m^3/hr, Speed = 1490RPM, Diameter 1200mm, Power input = 5MW. The manufacturer plans to build the model. The test conditions are: Electric power input = 500 kW, Flow rate = 0.5m^3/s of cold water. If the model and the prototype efficiencies are same, find the head, speed and scale ratio of the model. Also calculate the dimensioned and dimensionless specific speeds of the prototype. **05**

1B. Derive an expression for utilization factor of a turbine in terms of degree of reaction and inlet and exit absolute velocities of fluid. **05**

2A. For a certain radial flow turbine, following data is given. Draw the velocity diagrams and determine the energy transfer per unit mass of the fluid. Inlet dia. of runner = 4.5m, Outlet dia. of the runner = 2m, Inlet Blade Angle = 120°, Outlet Blade Angle = 30°, Speed of the Runner = 520RPM, Inlet Absolute Velocity = 200m/s, Outlet absolute Velocity = 60m/s. **05**

2B. Obtain an expression for infinitesimal polytropic efficiency as applicable for an expansion process in a turbine. Hence deduce the expression for overall efficiency for N stages of a turbine. Sketch the process on T-s diagram. **05**

3A. Derive an expression for stodola slip factor in terms of exit blade angle and number of impeller blades in a centrifugal pump. Deduce it for radial bladed impeller. **05**

3B. A centrifugal blower runs at a speed of 3000 rpm. Its impeller outer diameter is 750mm. The impeller blades are designed for a constant radial velocity of 60 m/s. The inlet is set such that the flow is shock-less. If the degree of reaction is 0.58, compute the exit blade angle and the head developed by the impeller. If the total to total isentropic efficiency is 0.75, find the stagnation pressure rise across the blower. The total pressure at the inlet is 1 bar and the total temperature is 25°C. **05**

4A. Derive an expression for degree of reaction of an axial flow compressor in terms of flow coefficient, inlet flow angle and exit blade angle. **05**

4B. Determine the discharge, the least jet diameter, the mean diameter of the runner, the Jet ratio, and the number of buckets for the following Pelton Turbine. Power = 150kW, Head = 300m, Speed = 600RPM, Speed Ratio = 0.45, Coefficient of Jet = 0.98, Overall efficiency of the turbine = 75%. **05**

5A. Show that a draft tube provided at the exit of reaction turbines maintains a lower pressure compared to atmospheric pressure. Also deduce the expression for draft tube efficiency. **05**

5B. The nozzle of a simple impulse turbine is inclined at an angle of 20° to the direction of path of moving blade and steam leaves the nozzle at 375 m/s. The rotor speed is 165 m/s. Find suitable inlet and outlet blade angles so that there shall not be any axial thrust on the blades. Allowing the velocity of steam in passing over the blades being reduced by 15%, determine the power developed for unit mass flow rate and utilization factor. How much energy is lost during the flow over the blades due to friction? **05**