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MANIPAL INSTITUTE OF TECHNOLOGY
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V SEM. B.TECH. (MECHANICAL ENGINEERING) DEGREE END SEMESTER (MAKE UP) EXAMINATIONS DEC 2015/JAN 2016

SUBJECT: TURBO MACHINES (MME - 305)

REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **ANY FIVE FULL** questions.

1A Deduce an expression for Mass and Speed parameter from dimensional analysis of a compressible flow Turbo machine. 05

1B In a certain turbo machine, fluid enters the rotor with an absolute velocity having a radial component of 20 m/s and a tangential component of 40 m/s. The tangential speed of the rotor at inlet is 35 m/s and at outlet 10m/s. The absolute velocity of fluid at rotor outlet is 15 m/s and is in the radial direction. Evaluate the energy transfer as work between the fluid and the rotor. What is the change in the total pressure of the fluid across the machine? What percentage of pressure is due to the dynamic head? Determine the degree of reaction. 05

2A Explain with the help of velocity triangles how the head versus discharge characteristics curve gets influenced in terms of the exit blade angle of the impeller for a centrifugal turbo machine. 05

2B The overall pressure ratio for a three stage gas turbine is 11 and its efficiency is 88%. If the pressure ratio is the same and the inlet temperature is 1500 K, Determine i) stage efficiency ii) reheat factor iii) polytropic efficiency iv) pressure ratio in each stage v) exit temperature. Assume C_p= 1.005 kJ/kg K and $\gamma = 1.4$ 05

3A Derive an expression for the overall efficiency of a multi stage gas turbine in terms of polytropic efficiency and pressure ratio. 05

3B A Centrifugal Pump lifts water under a static head of 40 m of which 4 m is the suction lift. Suction and delivery pipes are each 150 mm in diameter. The head loss in the suction pipe is 2.3 m and in delivery pipe is 7.4 m. The impeller is 420 mm in diameter and 25 mm wide at its tip and revolves at 1200 RPM. Its exit blade angle is 35^0. If the manometric efficiency is 82%, overall efficiency is 72% Compute i) Discharge from the pump ii) Power required to drive the pump iii) Pressure and Suction gauge readings. 05

4A What are the causes for surging and stalling in the compressors? What are the precautions to be taken to prevent the same? 05

4B A radial flow hydraulic Turbine is required to be designed to produce 30 MW under a Head of 14 m at a Speed of 95 RPM. A geometrically similar Model with an output of 40 kW and a Head of 5 m is to be tested under dynamically similar conditions. At what speed the model should run? What is the scale ratio of the model to the prototype and discharge through the model, if its efficiency is assumed to be the same? 05

5A What is the importance of compounding of steam turbines? Explain with neat sketches velocity compounding and pressure compounding. 05

5B The available pressure at the nozzle of a Pelton Turbine when it is closed is equal to 1.5 MN/m2.The velocity coefficient of jet is 0.96. The relative velocity of water turns through an angle of 150° and is reduced by 15% due to friction losses. The required ratio of bucket speed to the jet speed is 0.47 and 80% of the power developed by the wheel is available at output shaft. Find the jet diameter to develop 200 kW under the above conditions. 05

6A With neat sketch explain significance of Iso-efficiency curves and governing of Pelton turbine. 05

6B A stage of an Impulse turbine consists of a ring of nozzles followed by a ring of moving blades. The nozzle angle is 20° and moving blades have both inlet and outlet tips at 30° with respect to axial direction. If the velocity of steam at the exit of the nozzle is 300 m/s find the blade speed, diagram efficiency and Power developed if steam consumption is 1000 kg/hour. 05