MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHANICAL ENGINEERING)

END SEMESTER MAKE UP EXAMINATIONS DEC 2016/JAN 2017

SUBJECT: TURBO MACHINES [MME 3101]

REVISED CREDIT SYSTEM
(31/12/2016)

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:
❖ Answer **ALL** the questions.
❖ Missing data may be suitable assumed.

1A. Define unit speed, unit discharge and unit power. Derive the expressions for the same with usual notations — **05**

1B. A 50% degree of reaction axial flow turbo machine running at 3000 rpm, mean blade diameter is 685 mm. If the maximum utilization factor is 0.915, Calculate the inlet and outlet absolute velocities for the rotor and power output for a steam flow rate of 15 kg/s. Neglect axial thrust in the rotor. — **05**

2A. What is compounding in steam turbines? With neat sketches differentiate between velocity compounding and pressure compounding — **05**

2B. A Pelton turbine produces 15 MW under a head of 300 m. The turbine speed is 500 rpm. Assuming a turbine efficiency of 84%, coefficient of jet as 0.97, blade Speed ratio of 0.46, a bucket coefficient of 0.85, a jet ratio of 9.5, and assuming the deflection angle of the jet over the bucket as 165°, Compute the number of jets required and the diameter of each Jet as well as tangential force exerted by each jet on the bucket — **05**

3A. Derive Euler's equation for energy transfer in turbo machines. Hence discuss the three important components of energy transfer — **05**

3B. An air compressor has eight stages of equal pressure ratio of 1.35. The flow rate through the compressor and its overall efficiency are 50 kg/s and 82% respectively. If the condition of air at entry are 1 bar and 40°C, determine (i) the state of air at compressor exit (b) polytrophic efficiency(iii) efficiency of each stage and (iv) power required to drive the compressor as well as power required in each stage   **05**

4A. What is slip? Deduce an expression for stodola's slip factor.   **05**

4B. A single stage centrifugal pump lifts 50 liters/s of water at 1800 RPM. The diameter of the impeller is 250 mm and power required to run the same is 20 kW. Determine diameter of each impeller of multistage pump which has dynamically similar impellers and which delivers 75 liters/s of water running at 1200 RPM. Determine the number of stages required of the multistage pump if the total head developed by this pump is 155 m.   **05**

5A With velocity diagrams derive an equation for the total stage pressure rise in an axial flow compressor   **05**

5B CF pump handling water has impeller tip diameter of 0.5 m. The exit blade angle is 45°. If the radial velocity at exit is 15 m/s, the flow at inlet being axial shock-less entry. The impeller manometric efficiency is 70%. Find (a) Speed of the Impeller (b) Manometric head assuming that the hydraulic loss of head in the impeller is 5m and 40% of the kinetic head at the impeller exit is recovered through volute casing.   **05**