BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

Prime Movers & Fluid Machines (ME F341)

Comprehensive Examination (Second Semester 2021-22)

Date 17/05/2022 Weightage: 35% (70 marks)

Note: Attempt all questions in sequence. Underline final answers. State clearly any assumption you make. Start a new question from a fresh page.

Q.1 A backward curved centrifugal pump with outlet vane angle 25^o is running at 800 rpm. The head and discharge are 25 m and 0.2 m^3/s, respectively. The manometric efficiency is 0.85. Determine the diameter and width of the impeller at the outlet if the flow velocity at the outlet is four m/s. Draw velocity triangles. [12]

Q.2 A centrifugal compressor delivers 1.25 kg/s of air while running at 6000 rpm. The diameters at the inlet and outlet are 0.5 m and 1 m, respectively. The power input factor is 1.04, while the slip factor is unity. The absolute velocity at the inlet is 50 m/s and is in the axial direction. The compressor consumes 50 kW of power with an isentropic efficiency of 90%. Assume flow velocity to be constant. State the type of impeller used. Draw the velocity triangles and determine blade angles and the angle made by the absolute velocity at the inlet and outlet. Also, determine the pressure coefficient. [15]

Q.3 Stalling leads to a surge cycle in the axial flow compressor. Do you agree with this statement? Justify your answer with proper illustrations. [5]

Q.4 Explain using T-s or h-s plot the super saturated flow of steam in nozzle. [3]

Q.5 A model of a turbine, one-tenth of the actual size, is tested under a head of 5 m when the actual head for the prototype is 8.5 m. The power to be developed by the prototype is 8 MW. Determine the speed, discharge, and power of the model when the prototype is running at 120 rpm and at an overall efficiency of 85%. [9]

Q.6 a) Gas turbine blades are cooled using some fluid. Is it a correct statement? Justify your answer with a neat sketch. [5]

Q.6 b) There is a limitation of maximum temperature in gas turbines. Is it correct? justify your answer in comparison to SI engines used in two-wheelers. [5]

Q.7 A reaction turbine with a rotor diameter of 1250 mm rotates at 2500 rpm. The stage is designed so that the enthalpy drop in both the rotor and stator is the same. If the speed ratio is 0.7 and the blade angle at the outlet is 20^o, draw the velocity triangles and determine the blade angle at the inlet and the diagram efficiency. The turbine has to be redesigned for maximum diagram efficiency. Under which condition will you get the maximum diagram efficiency keeping the same blade angles, and what will the diagram efficiency value be? [16]

***** BEST LUCK *****