12

Program: B. Sc. in Mechanical Engineering
Semester: 5th

Date: 09 October, 2023
Time: 10:30 am – 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course Number: ME 4511
Course Title: Fluid Mechanics 2

Winter Semester: 2022 - 2023
Full Marks: 75
Time : 1.5 Hours

There are **03 (three)** questions. Answer **all** questions (choose option from question 1). The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable data for any missing values.

---

1. (a) "To achieve supersonic flow from a subsonic state in a duct, a converging-diverging area variation is necessary"- describe elaborately with all appropriate diagrams. **(10+15) (CO1) (PO1)**

(b) Explain characteristic features for variations of back pressure for the flow through converging-diverging ducts. Draw appropriate diagrams with pressure distribution lines along the length of the duct.

OR

(a) "For supersonic flow through a duct, the area-velocity relationship is proportional"- describe the statement through mathematical proof and expression with appropriate diagrams.

(b) Explain characteristic features for variations of back pressure for the flow through converging-diverging ducts. Draw appropriate diagrams with pressure distribution lines along the length of the duct.

2. A shaft is supported by journal, thrust and collar bearing as shown in Fig. 1. The external and internal radii of a collar are 60 mm and 50 mm, respectively. An oil film of thickness 0.26 mm and viscosity of 0.1 N-s/m^2 is maintained for collar and thrust bearing. Journal bearing has film thickness half of the collar bearing with viscosity of 0.15 N-s/m^2. If the speed of the shaft is 700 rpm, find the total force, total torque and total power absorbed in overcoming the viscous resistance. **(25) (CO2) (PO2)**

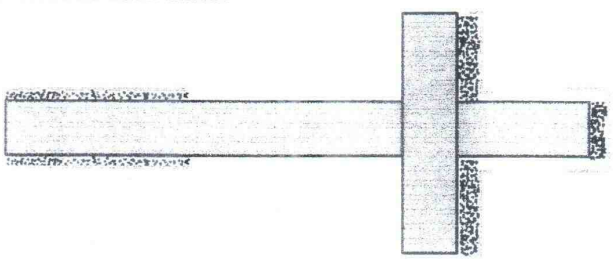

Figure 1

3. Standard atmospheric air is drawn steadily through a frictionless, adiabatic converging nozzle into an adiabatic, constant-area duct as shown in Fig. 2. The duct is 2-m long and has an inside diameter of 0.1 m. The average friction factor for the duct is estimated as being equal to 0.02. What is the maximum mass flowrate through the duct? For this maximum flow rate, determine the values of static temperature, static pressure, stagnation temperature, stagnation pressure, and velocity at the inlet [section 1] and exit [section 2] of the constant-area duct. Sketch a temperature-entropy diagram for this flow. **(25) (CO3) (PO2)**

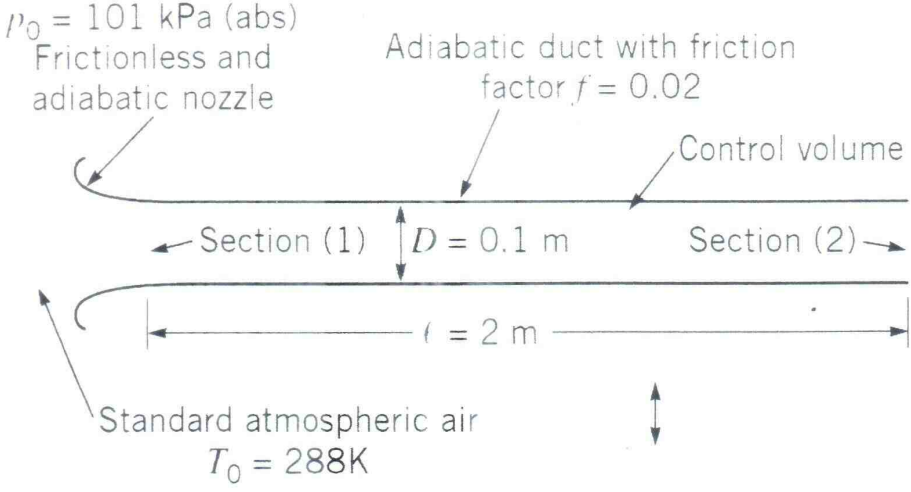

Figure 2