

R22

Code No: 183AZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year I Semester Examinations, February - 2024

FLUID MECHANICS

(Civil Engineering)

Time: 3 Hours

Max. Marks: 60

Note: This question paper contains two parts A and B.

i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A

(10 Marks)

- Convert 1 kg/s-m dynamic viscosity in poise. [1]
- What do you understand by Hydrostatic law? [1]
- With an example distinguish between rotational and irrotational flow. [1]
- What is difference between pitot-tube and pitot-static tube? [1]
- Define the terms i) notch ii) crest. [1]
- Write Bernoulli's equation. [1]
- What are the factors influencing the frictional loss in pipe flow. [1]
- Define velocity gradient. [1]
- Define i) drag ii) lift. [1]
- What is the effect of pressure gradient on boundary layer separation? [1]

PART - B

(50 Marks)

- Glycerin has a density of 1260 kg/m^3 and a kinematic viscosity of $0.001183 \text{ m}^2/\text{s}$. What shear stress is required to deform this fluid at a strain rate of 10^4 s^{-1} ?
- A pipe contains an oil of specific gravity 0.8. A differential manometer connected at the two points A and B of the pipe shows a difference in mercury level as 20 cm. Find the difference of pressure at the two points. [5+5]

OR

- Droplets of kerosene having diameter of 0.04 mm are produced in a atomiser. What is the pressure within these droplets? Take surface tension of kerosene as 0.026 N/m.
- A tank contains water upto a height of 1 m above the base. An immiscible liquid of sp.gr. 0.8 is filled on the top of water upto 1.5 m height. Calculate i) total pressure on one side of tank ii) the position of centre of pressure for one side of the tank, which is 3 m wide. [5+5]

- For a three-dimensional flow the velocity distribution is given by $u = -x$, $v = 3 - y$ and $w = 3 - z$. What is the equation of a stream line passing through (1,2,2)?
- State and prove Bernoulli's theorem. [5+5]

OR

- 5.a) Show that in an inviscid, proportional flow the stream lines and equ-potential lines cross each other at right angles.
- b) The water is flowing through a taper pipe of length 50 m having diameters 40 cm at the upper end and 20 cm at the lower end, at the rate of 60 liters/s. The pipe has a slope of 1 in 40. Find the pressure at the lower end if the pressure at the higher level is 24.525 N/cm^2 . [5+5]

- 6.a) Find the time required to lower the water level from 3 m to 1.5 m in a reservoir of dimensions $70 \text{ m} \times 70 \text{ m}$, by a rectangular notch of length 2.0 m, take $C_d=0.60$.
- b) A Venturi meter of throat diameter 5cm is fitted into a 12.5 cm diameter water pipe line. The coefficient of discharge is 0.96. Calculate the flow in the pipe line when the reading on a mercury water differential U tube manometer connected to the upstream and throat sections shows a reading of 20 cm. [5+5]

OR

- 7.a) A venturi meter is to be fitted in a pipe of 25 cm diameter where the pressure head is 7.6m of flowing liquid and the maximum flow is 8200 liters per minute. Find the least diameter of the throat to ensure that the pressure head does not become negative. Take $C_d = 0.96$.
- b) What are the different types of notches? Explain Rectangular and Stepped notches. [5+5]

- 8.a) Water is flowing through a rough pipe of diameter 50 cm and length 2000 m at the rate of $0.3 \text{ m}^3/\text{s}$. Find the power required to maintain this flow. Take the average height of roughness as 0.3 mm. The density and kinematic viscosity of water at 20°C are 1000 kg/m^3 and $1 \times 10^{-6} \text{ m}^2/\text{s}$ respectively.
- b) A pumping plant forces water through a 60 cm diameter main, the friction head being 27 m. In order to reduce the power consumption, it is proposed to lay another main of appropriate diameter alongside existing one, so that two pipes may work in parallel for the entire length and reduce the friction head to 9.60 m long. Find the diameter of the new main if with the exception of the diameter it is similar to the existing one in every aspect. [5+5]

OR

- 9.a) Water is discharged from one tank to another with 30 m difference of water levels through a pipe 1200 m long. The diameter for the first 600 m length of the pipe is 400 mm and 250 mm for the remaining 600 m long. Find the discharge in lit/s through the pipe. Assume the coefficient of friction as 0.008 for both the pipes.
- b) Two pipes each 300 m long are available for connecting to a reservoir from which a flow of $0.085 \text{ m}^3/\text{s}$ is required. If diameters of the two pipes are 300 mm and 150 mm respectively, determine the ratio of head lost when the pipes are connected in series to the head lost when connected in parallel. Neglect minor losses. [5+5]

- 10.a) What are the characteristics of laminar and turbulent boundary layer?
- b) A small sphere of diameter D and density ρ_s is dropped into a large body of fluid of density ρ_f . Calculate the terminal velocity of the sphere. i) by assuming the the Stoke's law is applicable ii) in terms of the drag coefficient. [5+5]

OR

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11.a) Define physically and mathematically the concept of displacement, momentum and energy thickness of a boundary layer.

QA

b) Find the ratio of skin friction drag on the front two thirds and rear one third of a smooth flat plate in a uniform stream at zero incidence. Assume the boundary layer to be turbulent and the Reynolds number to be of the order of 10^6 . [5+5]

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