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NPTEL

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Courses » Fluid dynamics and turbomachines

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## Week #7.

# PERFORMANCE OF PUMPS AND HYDRAULIC TURBINES

### Course outline

How to access the portal

Pre-requisite Assignment

Course Content

Week #1.  
INTRODUCTION TO FLUID FLOWS

Week #2.  
INTEGRAL ANALYSIS

Week #3.  
DIFFERENTIAL ANALYSIS

Week #4.  
VISCOUS FLOW

Week #5.  
INTRODUCTION TO TURBOMACHINES

Week #6.  
PRINCIPLE OF TURBOMACHINES

Week #7.  
PERFORMANCE

## Assignment 7

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment. **Due on 2018-09-26, 23:59 IST.**

### Instructions:

1. For questions (1-7): fill in the blanks
2. For questions (8-11): select the most appropriate option.
3. Take density of water as  $1000 \text{ kg/m}^3$  and acceleration due to gravity as  $9.81 \text{ m/s}^2$ .

**Note: The numerical value marked in red colour is correct answer while the answers within the numerical range of value given in the blue colour are considered as correct answer.**

A pump draws water at the rate of  $0.018 \text{ m}^3/\text{s}$  from a large reservoir open to atmosphere with pressure  $101.325 \text{ kPa}$ . The pump is situated at a height of  $4.5 \text{ m}$  above the reservoir surface. The pipe diameter is  $7.5 \text{ cm}$ , and the suction pipe is  $10 \text{ m}$  in length. The entrance loss in suction pipe is  $0.7$  times velocity head in the pipe, elbow loss in the suction pipe is  $0.5$  times velocity head in the pipe. Darcy friction factor is  $0.02$ . Assume vapour pressure at ambient temperature to be  $3000 \text{ Pa}$  and density of water  $1000 \text{ kg/m}^3$ .

- 1) Total loss in the suction side piping system is..... (m).

Hint

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(Type: Range) **3.15,3.35**

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- Lec03 - Hydraulic Turbines: Pelton Turbine
- Lec04 - Hydraulic Turbines: Reaction Turbines
- Lec05 - Cavitation in Hydroturbomachines
- Lec06 - Tutorial
- Week-7 Lec-1 Pumps Presentation
- Week-7 Lec-2 Pumping Systems Presentation
- Week-7 Lec-3 Hydraulic Turbines: Pelton Wheel Presentation
- Week-7 Lec-4 Hydraulic Turbines: Reaction Turbines Presentation
- Week-7 Lec-5 Cavitation in Hydroturbomachines Presentation
- Quiz : Assignment 7
- WEEK 7 - FEEDBACK - Fluid dynamics and turbomachines
- Assignment 7 solution

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**Week #8.**  
**PERFORMANCE OF STEAM AND GAS TURBINES**

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Hint

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 2.15,2.35

5 points

A Francis turbine has an outer diameter of 1.4 m and reduces at 430 rpm. Water enters the runner tangentially with a flow velocity of 9.5 m/s and leaves the runner with zero exit whirl with an absolute velocity 7 m/s. The difference between the sum of the static and potential heads at entrance to the runner and at the exit from the runner is 62 m. If the turbine develops 12250 kW and has a flow rate of 12 m<sup>3</sup>/s of water when the net head is 115 m,

3) The whirl component of absolute velocity of the water at the entry of runner is ..... (m/s)

Hint

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 30,35

6 points

4) The angle of inlet guide vanes is .....(°)

Hint

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 15,17.5

6 points

The buckets of a Pelton wheel deflect the jet through an angle of 170°, while the relative velocity of the water is reduced by 12 % due to the bucket friction. Bucket to jet speed ratio of 0.47. Under a net head of 552 m the wheel develops 1250 kW. The bucket circle diameter of the wheel is 900 mm and there are two jets. The nozzle velocity co-efficient is 0.98. Neglect splitter angle.

5) The speed of rotation of the wheel is ..... (rpm).

Hint

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 930,1025

6 points

6) The hydraulic efficiency based on the kinetic energy of the jet is ..... (%)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 92,94

3 points

7) Diameter of the nozzles is ..... (m).

Hint

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.035,0.045

3 points

A Kaplan turbine designed for 15 MW at 250 rpm has a specific speed of 320 rpm. The impeller blades are such that the water leaves the turbine axially. The hydraulic efficiency is 0.90 and overall efficiency is 0.85.

8) Flow rate is ..... ( $\text{m}^3/\text{s}$ )

6 points

- 23.4
- 32.4
- 46.8
- 64.8

No, the answer is incorrect.

Score: 0

Accepted Answers:

46.8

9) Impeller specific work is ..... ( $\text{m}^2/\text{s}^2$ ).

5 points

- 113.1
- 339.3
- 553.9
- 678.6

No, the answer is incorrect.

Score: 0

Accepted Answers:

339.3

10) Which of the following is an example of an impulse turbine?

2 points

- Propeller turbine
- Francis turbine
- Kaplan turbine
- Pelton turbine

No, the answer is incorrect.

Score: 0

Accepted Answers:

*Pelton turbine*

11) Among the following locations inside a hydraulic turbine, which is the most susceptible to cavitation? **2 points**

- inlet of draft tube
- draft tube exit
- spiral casing exit
- guide blade inlet

No, the answer is incorrect.

Score: 0

Accepted Answers:

*inlet of draft tube*

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