



RAMCO INSTITUTE OF TECHNOLOGY

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Department of Mechanical Engineering
Academic Year 2021 – 2022 (Even Semester)

Degree, Semester & Branch: VI Semester B.E. Mechanical Engineering

Course Code & Title: ME8693 Heat and Mass Transfer

Name of the Faculty member(s): Dr.V.Sivakumar, ACSP/ Mechanical

Mr.M.Ashok Kumar, AP (SG)/Mechanical

Date of Practice: 31.03.2022

Innovative Practice Description

Unit / Topic: Unit – II / Hydrodynamic Boundary Layer Thickness

Course Outcome: CO2 – The students will be able to apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.

Topic Learning Outcome: TLO: Draw the hydrodynamic and thermal boundary layer

Activity Chosen: Software tool used

Justification: The change in velocity profile of fluid while flow over the flat plate with respect to the distance shall be visualized by the students while using a software tool like MATLAB.

Time Allotted for the Activity: 15 min

Details of the Implementation:

The boundary layer thickness is measured perpendicular to the surface from the fluid velocity of $u = 0$ to $u = u_{\infty}$

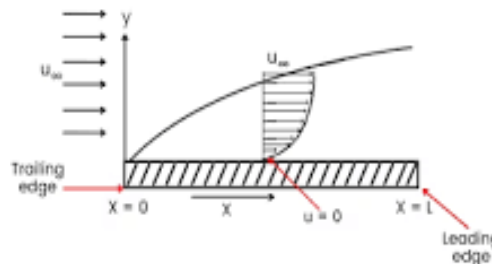


Fig. Boundary Layer Thickness [Source: <https://mechcontent.com/hydrodynamic-boundary-layer/>]

The velocity of the fluid particle at $y = \delta$ becomes equal to the u_{∞} . Therefore δ is the boundary layer thickness at the particular cross-section. In order to understand the boundary layer thickness variation with respect to the length, the boundary layer thickness has to be calculated for the different length manually and it is time consuming. So make the students to understand the concept of boundary layer thickness along the length of the plate, we encourage our students to calculate the boundary layer thickness with respect to the length by using MATLAB coding.

No. of Students: 24 + 23

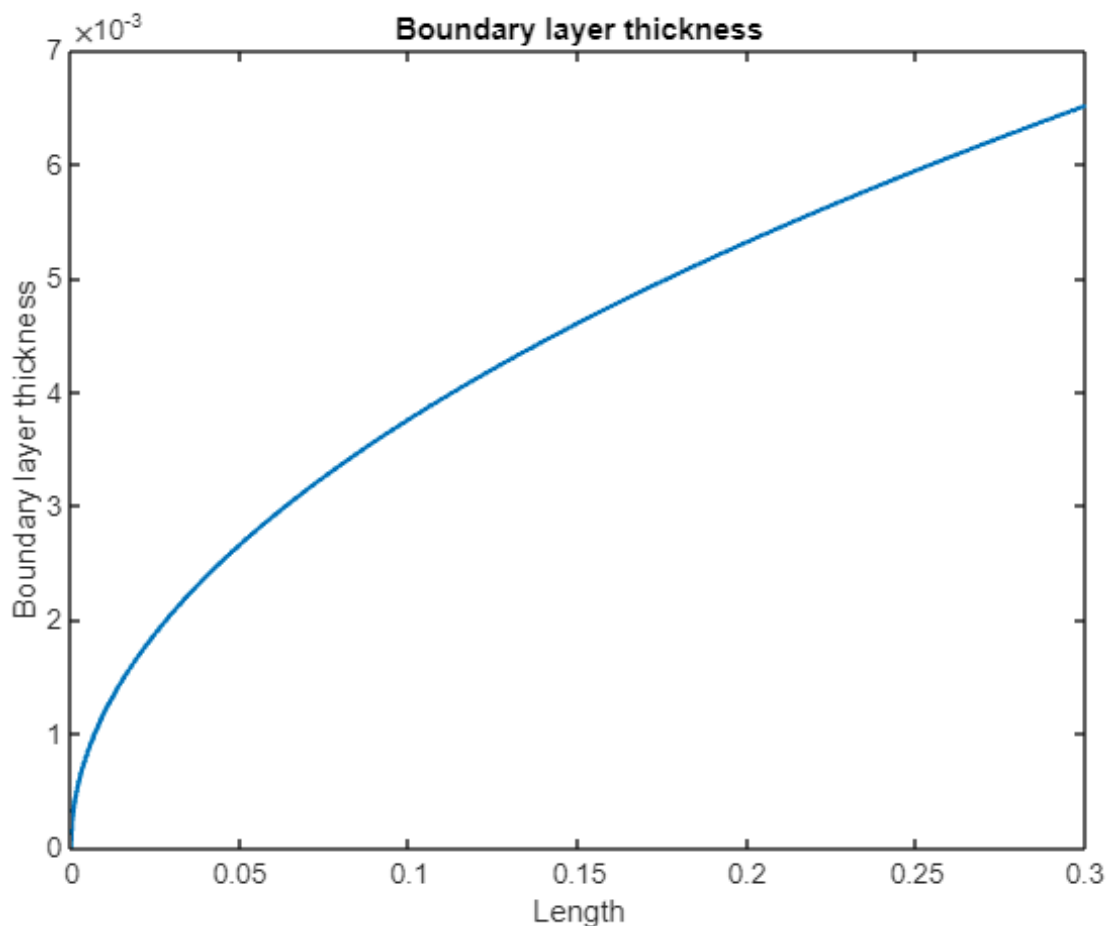
Problem Statement

A fluid is flowing at a velocity of 3 m/s along the 0.3 m x 0.3 m length of the plate. Draw the boundary layer thickness with respect to the length of the plate using MATLAB coding. Take the viscosity of the fluid as $0.00001696 \text{ m}^2/\text{s}$.

MATLAB Program:

```
viscosity = 0.00001696;  
u = 3;  
L = linspace(0,0.3,1000);  
layer = 5.*L.*((u.*L./viscosity).^(-0.5))  
plot(L,layer, 'LineWidth',1.5)  
set(gca, 'fontsize',09)  
xlabel('Length')  
ylabel('Boundary layer thickness')  
title('Boundary layer thickness')
```

Output:



PO / PSO mapping for the activity:

Innovative Practice	PO1	PO2	PO5	PSO3
Level of mapping	3	3	1	3
Justification for correlation	To solve the problem the student will apply the mathematics, science and engineering fundamentals. Level - 3	Derive the formula using mathematics, natural science and engineering science to calculate the performance parameters – Level 3	Software is used to validate the temperature distribution of short fin with end insulated. Level - 1	The basic concepts required for performing heat conduction analysis is taught in this unit. Level - 3

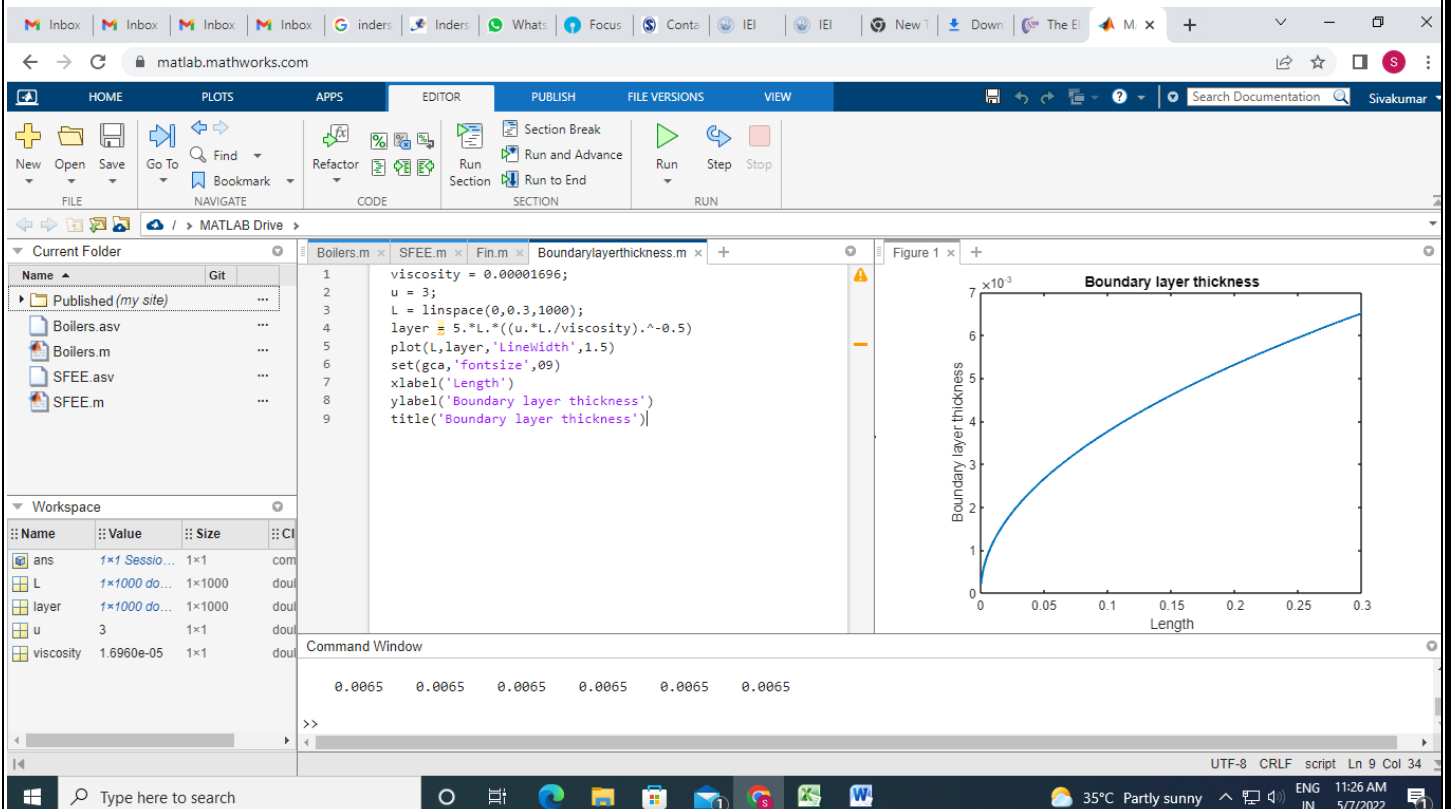
(1 – Low 2 – Moderate 3 – High)

CO – PO / PSO mapping:

CO	PO1	PO2	PO5	PO9	PSO3
CO1	3	3	1	1	3

(1 – Low 2 – Moderate 3 – High)

Images / Screenshot of the practice:



Reflective Critique:

- **Feedback of practice from students and other stakeholders:** (samples to be enclosed)

Feedback received from students and the sample is enclosed

- **Benefit of the practice:** The students can be easily visualizing the change in velocity profile with respect to distance in flow over the flat plate based on viscosity and free stream velocity of the fluid.

- **Whether the practice is adopted in any of the courses early: Yes**
(If yes provide the details and the modifications you have adopted)

A new program is developed by using the command linspace and plot in MATLAB and change in velocity profile with respect to distance in flow over the flat plate based on viscosity and free stream velocity of the fluid in a graphical form is not adopted in other courses which are adopted in this course heat and mass transfer.

- **Challenges faced in implementation:** Nil

- **References:**

- Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015
- Rao V. Dukkipati., "MATLAB for Mechanical Engineers", First edition, New Age International Publishers, 2008.

CO1: The students will be able to apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.

Signature of Faculty Member

HOD

Student feedback on Innovative Practice

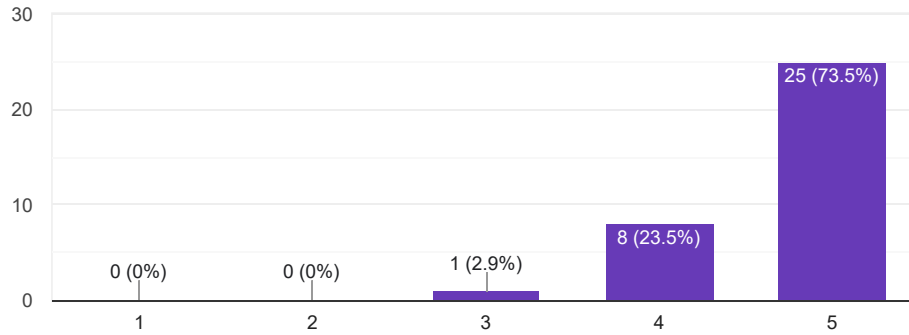
34 responses

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Instructor clarifies difficult aspects of this innovative activity.

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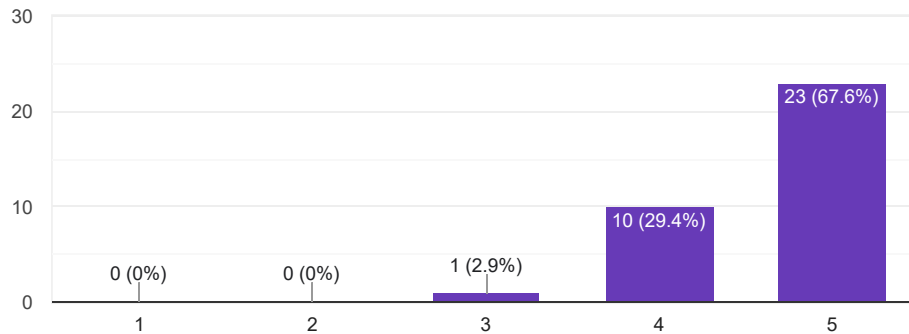
34 responses



This innovative activity improves my opinion about the content of the subject

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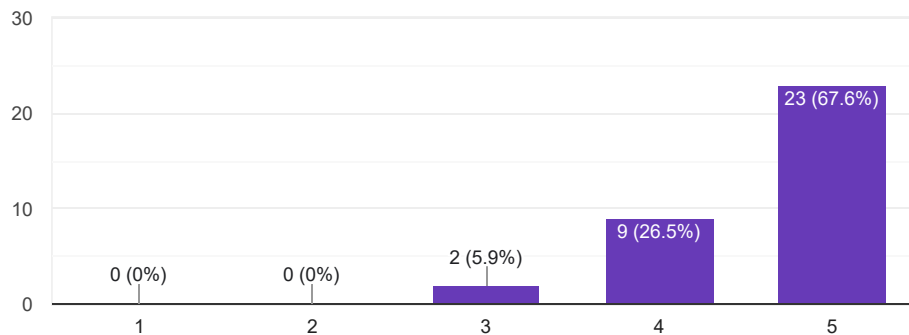
34 responses



I find new information about the topics and subjects using new technologies.

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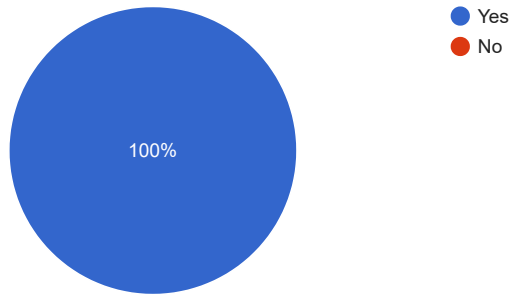
34 responses



I suggest this innovative practice to teach the topic for forthcoming students



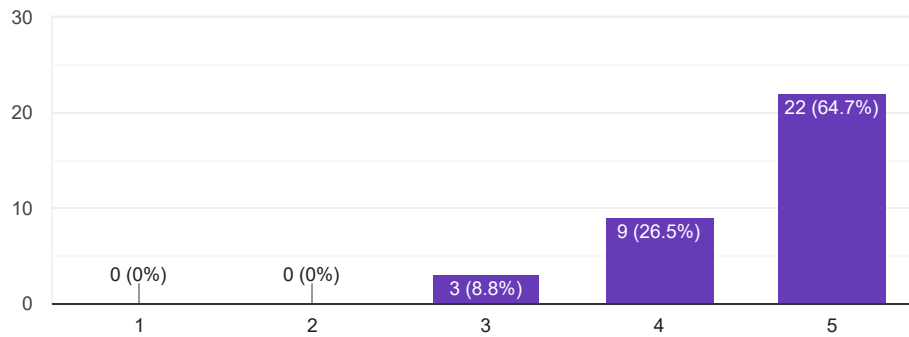
34 responses



This innovative activity builds any self-confidence to understand the content of the delivery.



34 responses



The most useful thing/skill I learned from this activity was...

34 responses

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Yes

Coding knowledge

innovative thinking capacity

Use of matlab



Yes,useful

Useful

I can analyse the heat transfer between the system

N/A

MATLAB utilization

How to do the problem in different way

Good

For each node we can know the required definition value.

Knowledge Enrichment

Good

Coding

Pictorial content was easier to understand

Use of morden ideas

Use of innovative ideas in solving problems in easy way and accurately...

Yes useful

basics of thermal concept in matlab

All

N

