

Karamadai, Coimbatore - 641104 (Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai) Ph: +91 91500 76729 Email: principal@ckec.ac.in Web: www.ckec.ac.in

#### PERMISSION LETTER

Date: 01-03-2021

#### From

Mr. Prabhu C

Course Coordinator

Department of Mechanical Engineering

Christ the King Engineering College

Coimbatore

#### То

The Principal

Christ the King Engineering College

Coimbatore

Through : Head of The Department / Mechanical Engineering

#### **Respected Sir**,

Sub: Requesting permission to organize a Value Added Course on "Overview of CFD process: Pre-processing, solving, post-processing" - Reg.

Department of Mechanical Engineering is planning to organize a Value Added Course on "Overview of CFD process: Pre-processing, solving, post-processing" from 03.03.2021 to 19.03.2021 for Final year Mechanical Engineering students. Mr. Hari Prasath R, Head of The Department, Department of Mechanical Engineering as a Resource Person. In this regard, we seek your permission to conduct the same in the CAD Lab from 03.03.2021 to 19.03.2021 from 4 pm to 7 pm. Kindly consider our request and grant the same.

Thanking You,

AR, M.E., Ph.D. Dr.M.JE

PRINCIPAL CURIST THE KING ENGINEERING COLLEGE, Chikkarampalayam Village, Karamadai, Mettupalayam Taluk, Combatore - 641 104.



Yours truly,

Approved



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## DEPARTMENT OF MECHANICAL ENGINEERING

Ref.No: CKEC/MECH/VAC/20-21/002

DATE: 02-03-2021

#### CIRCULAR

This is to inform that the department of Mechanical engineering is planning to conduct a value-added course on "OVERVIEW OF CFD PROCESS: PRE-PROCESSING, SOLVING, POST-PROCESSING" for all final year students on 03.03.2021 to 19.03.2021 Students are asked to register you and utilize this opportunity to improve their skills.

S. No	Course Code	Name of the Course	Departmen t	No of Hours	Course Coordinator
1	VAME2004	OVERVIEW OF CFD PROCESS: PRE- PROCESSING, SOLVING, POST- PROCESSING	Mech	35	Mr. Prabhu C

Note: The circular Display in the department Notice board for student's attention.

Copy to: Principal's Desk Notice board

UMAR, M.E., Ph.D.

Dr.M.JEYAKUMAR, M.E., Ph.D. PRINCIPAL CHRIST THE KING ENGINEERING COLLEGE, Chikkarampalayam Village, Karamadai, Mettupalayam Taluk, Combatore - 641 104.





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## DEPARTMENT OF MECHANICAL ENGINEERING

Organizes Value Added Course on **OVERVIEW OF CFD PROCESS: PRE-PROCESSING,** SOLVING, POST-PROCESSING 03.03.2021 TO 19.03.2021 (4 TO 7PM)

Resource Person

Mr. R. Hari Prasath Head of The Department **Department of Mechanical Engineering For IV Year Students** 

> CHIEF PATRON Dr. M. Jeyakumar Principal

Venue: CAD Lab

PATRON Dr. R. Hari Prasath **HOD / MECH** 

COORDINATOR Mr. C. Prabhu AP / MECH

WI.M.JEN AR. M.E.Ph.D. RINCIPAL IST THE KING ENGINEERING COLLEGE, Ehikkarampalayam Village, Kalfamadai, Meitupalayam Taluk, Chumbatare - 641 104.





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## DEPARTMENT OF MECHANICAL ENGINEERING

Course Code	VAME2004
Name Of the Course	OVERVIEW OF CFD PROCESS: PRE-PROCESSING, SOLVING, POST-PROCESSING
Duration Of the Course	35 Hours
Academic Year	2020-2021
Period Of the Course	15 Days

#### **COURSE OBJECTIVES:**

- Learn how to create geometry, generate grids, and specify equations and boundary conditions for a CFD simulation.
- Understand how commercial CFD solvers operate as "black boxes" and explore user interventions for specifying solution methods, discretization schemes, and convergence checks.
- Gain proficiency in extracting and manipulating relevant data from raw solver outputs, such as field variables, surface pressures, shear stresses, and cell-face areas.
- Familiarize yourself with popular commercial CFD codes like STAR-CCM+, Fluent, FLOW-3D, PowerFLOW, and COMSOL, which offer grid generation and flow visualization capabilities.
- Get acquainted with open-source CFD solvers like OpenFOAM and CodeSaturne, which require knowledge of C++ or Fortran for usage.

#### Syllabus

## **UNIT I - GEOMETRY DEFINITION & MESH GENERATION**

Identify the domain of interest (fluid region) - Prepare the geometric model, ensuring it is free of errors (e.g., gaps, missing faces, overlapping surfaces) - Divide the domain into smaller segments (mesh cells or elements) - Generate a computational mesh (grid) that discretizes the geometry.

#### **UNIT II – MATERIAL PROPERTIES**

Define material properties (density, viscosity, thermal conductivity, etc.)

#### **UNIT III – NUMERICAL SOLUTION**

Solve the governing equations (e.g., Navier-Stokes equations) over the meshed model - Iteratively compute flow variables (velocity, pressure, temperature) using CFD solvers.

#### UNIT IV – SOLVER CAPABILITIES

Understand the capabilities and limitations of commercial CFD codes - Choose appropriate solver settings (turbulence models, discretization schemes).





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### **UNIT V – RESULTS ANALYSIS & VISUALIZATION**

Extract predicted physical quantities (velocity profiles, pressure distributions, temperature fields) - Qualitatively and quantitatively assess simulation outcomes - Use scientific visualization tools to visualize flow patterns and phenomena - Interpret and communicate simulation results effectively.

#### **TOTAL HOURS:34**

(6)

#### **COURSE OUTCOME:**

- Gain proficiency in creating geometry and generating grids.
- Specify equations to be solved and boundary conditions.
- Adapt pre-processing based on desired outputs and solver capabilities.
- Understand their grid-generation and flow-visualization capabilities.
- Explore open-source CFD solvers like OpenFOAM and CodeSaturne.

#### **TEXT BOOK & REFERENCES:**

- 1. "Computational Fluid Dynamics and Heat Transfer" By P.S. Ghoshdastidar, this book is for beginners and advanced students, and was published in 2017.
- 2. "An Introduction to Computational Fluid Dynamics: The Finite Volume Method" By Henk Kaarle Versteeg and Weeratunge Malalasekera, this illustrated book was published in 2007.
- 3. "Introduction to Computational Fluid Dynamics" By Atul Sharma, this book was published in 2021, and is in its first edition.

Dr.M.JEYA UMAR, M.E. Ph.D. PRINCIPAL. CHRIST THE KING ENGINEERING COLLEGE, Chikkarampalayam Village, Karamadai, Mettupalayam Taluk, Combatore - 641 104.





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## DEPARTMENT OF MECHANICAL ENGINEERING VAME2004 - Overview of CFD process: Pre-processing, Solving, Post-Processing

SCHEDULE

S. No	DAY	TIME/SESSION	CONTENT	RESOURCE PERSON
	03.03.2021	4.00-6.00pm	GEOMETRY DEFINITION & MESH	
1	04.03.2021	4.00-6.00pm	GENERATION & MESH	
	05.03.2021	4.00-7.00pm		
	06.03.2021	4.00-6.00pm		
2	08.03.2021	4.00-6.00pm	MATERIAL PROPERTIES	
	09.03.2021	4.00-7.00pm	•	
	10.03.2021	4.00-6.00pm		
	11.03.2021	4.00-6.00pm		Mr. Hari Prasath R
3			NUMERICAL SOLUTION	Head of The Department,
	12.03.2021	4.00-7.00pm		Department of Mechanical
		к.,		Engineering,
	13.03.2021	4.00-6.00pm		Christ the King Engineering College
4	15.03.2021	4.00-6.00pm	SOLVER CAPABILITIES	x
	16.03.2021	4.00-7.00pm		
	17.03.2021 4.00-7.00pm		RESULTS ANALYSIS &	
5	18.03.2021	4.00-7.00pm	VISUALIZATION	
-	19.03.2021	4.00-5.00pm	ASSESSMENT	





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#### DEPARTMENT OF MECHANICAL ENGINEERING VAME2004 - Overview of CFD process: Pre-processing, Solving, Post-Processing STUDENT DECISTRATION

STUDENT REGISTRATION							
S.NO.	REGISTER NUMBER	NAME OF THE STUDENT	SIGNATURE				
1	710417114001	Abex Abraham	Don				
2	710417114002	Abinesh A S	Abmer				
3	710417114005	Arun P	Aren				
4	710417114006	Athul Joshuwa	falmel Jun				
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Dr.M.JEYAKUMAR, M.E., Ph.D. PRINCIPAL CHRIST THE KING ENGINEERING COLLEGE, Chikkarampalayam Village,

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### DEPARTMENT OF MECHANICAL ENGINEERING VAME2004 - Overview of CFD process: Pre-processing, Solving, Post-Processing

	STUDENTS ATTENDANCE LIST							
	REGISTER	NAME OF THE	03.03.2021	04.03.2021	05.03.2021	06.03.2021	08.03.2021	
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Dr.M.JEYAKUMAR, M.E., Ph.O. PRINCIPAL CHRIST THE KING ENGINEERING COLLEGE, Chikkgrampaloyam Village, Karamadai, Methupaloyam Taluk,

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S.No	REGISTER	NAME OF THE	09.03.2021	10.03.2021	11.03.2021	12.03.2021	13.03.2021
5.10	NUMBER	STUDENT	4-7.00pm	4-6.00pm	4-6.00pm	4-7.00pm	4-6.00pm
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Dr.M.JEYAKUMAR, M.E. Ph.D. PRINCIFAL



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IR, M.E., Ph.D. Dr.M.JE PRINCIPAL CHRIST THE KING ENGINEERING COLLEGE, Chikkarampalayam Village, Karamadai, Mettupalayam Taluk, Coimbatore - 641 104.





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C No	REGISTER	NAME OF THE	15.03.2021	16.03.2021	17.03.2021	18.03.2021	19.03.2021
S.No	NUMBER	STUDENT	4-6.00pm	4-7.00pm	4-7.00pm	4-7.00pm	4-5.00pm
1	710417114001	Abex Abraham	An	A	to	As	do
2	710417114002	Abinesh A S	apinesh	Abinah	Abinosh	Abines	Abinash
3	710417114005	Arun P	Drun	Drun	Arun	Arun	Fryun
4	710417114006	Athul Joshuwa	Mar Sa	Att 5	AHAT	Athertan	Atta To
5	710417114007	Basil E George M	Re	Q_	B	B	Ba
6	710417114008	Basil James	Dig	Boni	Pricel	Basil	Basi
7	710417114010	Boopath Raja S	S.R.	(. Runt	Rul	Ruh	1.81
8	710417114011	Chandru B	AB	cling	ceny	cu	cury
9	710417114012	Churchil Xavier F	alden	0.1.0	ala	Kut	the '
10	710417114014	Ewain P Biju	du	Que	Que	Æ.	C.
11	710417114015	Franto Nithish A	X1,	dr~	ha	da	AB
12	710417114017	Jackson John George	1000	-	7	Ŷ	AB
13	710417114018	Jebinson J	Jehn	Jek	Test	Jole	John
14	710417114019	Jersheline T	Jest	- zash	Jegh	AB	Rehm
15	710417114020	Jobin K Joshy	P	and and	5	R	
16	710417114021	Jude Antony Raj D	V. h	, XA	SA	5 A	-
17	710417114022	Karthick.M(23.11.1999)	pie	pet	AB	Kue	kte
18	710417114023	Karthick M(17.07.2000)	Kne	R	Ð	KQ	RO
19	710417114024	Karthick N	book	Dont	the	AB	d.
20	710417114025	Kavish K M	Kauch	pough	rough	Kaush	Kaush
21	710417114026	Kevin Christopher S	a.	h	6	b	à
22	710417114027	Kisho Jers C J	11	on	14	ne	6 A
23	710417114029	Melvin Eaju	nen	alte	over	July	and
24	710417114031	Mohana Mathan.R	Nehan	Mohan	Mah	AB	Noha
25	710417114032	Murali Rajan.S	Mondial-	Murpiz	Andre	AB	Ameri
25	710417114033	Muthaya		1			
		Muralidharan.P	Mht.	N.	AB	MA	Nell -
27	710417114034	Prem Kumar. S	panto	pronto	prent	porto	Dont
28	710417114036	Ravi Shankar.P	Shalar	Standa	sconbe	Spage	Sala.
29	710417114037	Rayappan. K	Rajeppin	Rayppur	Rausson	Rougener	Rayappan
30	710417114038	Reshin Vince.V	Resp	AB	Risly.	Pela	Rest
31	710417114039	Sandeep .P	Jacol	sont	Sant	Shall	Sunda
32	710417114041	Sebin Joy	Sebin	Solin	AB	Reloin	
33	710417114042	Sunny Jacob	Janufreh	Surgorn	Scried.	Sunial	1 serp
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36	710417114045	Tilon Jose <	the .	the	CAN.	A de	THE
37	710417114046	Vetrivel. M	Verle	-verbe	VOTEO	Verto	Verb

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	<b>C</b>						
38	710417114047	Vijay.E	Vu	Von	Cu	an	En
39	710417114048	Yuvaraj.C	21-	AB	14-	Y	- 4
40	710417114301	Diwagar.S	Dury-	Dute	AB	Dut-	Bur
41	710417114302	Earnest Paul Raj.S	A	di	AB	AB	tr
42	710417114303	Esakki Kasi Viswanathan.D.C	Pear	de	- AB	Ku	ch
43	710417114304	Lokesh.K	Om	chen	An	- cha	ch
44	710417114305	Naveen Kumar.R	Ê,	f	Lu	ÅB	AB
45	710417114701	Gokula Krishnan.S	AB	A &	C- W	GK	Cale
46	710417114702	Pavan Kumar.P	Rue Ku	R. R.	ant	In h	la-kr
47	710417114703	Suyambu Raja Subin.V	SR	SR	SER	SR	Sel
48	710417114704	Gokulvasan.D	autre	Gen	Gen	-	Ch-
49	710417114705	Rangasamy.S	R	R	AB	R_	R
50	710417114706	Sujith Kannan.R	Sid pe	Sul h-	Sut h	Sythen	AB
51	710417114707	Shebin.B	8	Sa	5	S=	3_

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#### DEPARTMENT OF MECHANICAL ENGINEERING VAME2004 - Overview of CFD process: Pre-processing, Solving, Post-Processing <u>MULTIPLE CHOICE QUESTION</u>

1. What does geometry mean?

a) Measurement of land

b) Measurement of physical objects

c) Measurement of velocity

d) Measurement of pressure

2. Which of the following defines a mesh plot?

a) Vector representation of the mesh lines

b) Scalar representation of the mesh lines

c) Graphical representation of the mesh lines

d) Numerical representation of the mesh lines

3. Which of the following is a basic classification of Engineering Materials?

a) Metals

b) Non-Metals

c) Both Metals & Non-Metals

d) None of the mentioned

4. Which of the following is not a property of engineering materials?

a) Mechanical properties

b) Chemical properties

c) Polymorphism

d) Electrical properties

5. The solution of the equation (  $\frac{\delta u}{\delta u} = \frac{\delta u}{\delta u}$  ) with the boundary conditions (  $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: a) (  $u(x, t) = 3 \sum_{n=1}^{1} \frac{\sin(t)}{t} = \frac{-1}{2} \frac{\sin(n \sin x)}{t}$  ) b) (  $u(x, t) = 3 \sum_{n=1}^{1} \frac{\sin(t)}{t} \frac{\sin(t)}{t} = \frac{-1}{2} \frac{\sin(n \sin x)}{t}$  )

c) (  $u(x, t) = \sum {n=1}^{(\inf ty)} \frac{1}{(\inf ty)} \frac{1}{(\inf ty)}$ 

d) (  $u(x, t) = 3 \sum_{n=1}^{\min\{y} \frac{-n2\min\{2 t\}}{\sin(n \in x)}$  )

6. In a free space, a plane wave with (  $(z \mid eq 0)$  ) electric field (  $E_i = 40 \mid cos(10^8 t - beta z) \mid a_x, \quad text{V/m}$  ) is incident normally on a lossless medium ((  $varepsilon = 2 varepsilon_0$  ) and (  $mu = 5 \mid u_0$  )) in the region (  $z \mid eq 0$  ). The reflected electric field component is:

a) ( -40\eta\_0 \cos(10^8 -  $\frac{1}{3}z$ )\hat{a}\_y , \text{V/m} )

b) ( -9\eta\_0 \cos(10^8 t +  $frac{1}{3}z$ )\hat{a}\_y , \text{V/m} )

c) ( -1.6\eta\_0 \cos(10^8 t +  $frac{4}{3}z$ )\hat{a}\_y ,  $text{V/m}$  )

d) ( -9\eta\_0 \cos(10^8 t -  $\frac{4}{3}z$ )\hat{a}\_y , \text{V/m} )

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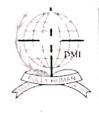
- 7. Numerical techniques more commonly involve:
- a) Elimination method
- b) Reduction method
- c) Iterative method
- d) Direct method

#### 8. Which of the following is an iterative method?

- a) Gauss Seidel
- b) Gauss Jordan
- c) Factorization
- d) Gauss Elimination
- 9. Which of the following is the advantage of using the Gauss Jordan method?
- a) Additional Calculations
- b) No labor of back substitution
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- d) Elimination is easier
- 10. Which are pros of data visualization?
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- c. It can be distracting.
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## DEPARTMENT OF MECHANICAL ENGINEERING VAME2004 - Overview of CFD process: Pre-processing, Solving, Post-Processing STUDENTS ASSESSMENT MARKS

S.NO	REG.NO	NAME OF THE STUDENT	MARKS 10
1	710417114001	Abex Abraham	9
2	710417114002	Abinesh A S	9
3	710417114005	Arun P	8
4	710417114006	Athul Joshuwa	8
5	710417114007	Basil E George M	B
6	710417114008	Basil James	8
7	710417114010	Boopathi Raja S	9
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22	710417114027	Kisho Jers C J	Ž
23	710417114029	McIvin Raju	6

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24	710417114031	Mohana Mathan.R 7		
25	710417114032	Murali Rajan.S 7		
26	710417114033	Muthaya Muralidharan.P		
27	710417114034	Prem Kumar. S	8	
28	710417114036	Ravi Shankar.P	9	
29	710417114037	Rayappan. K	6	
30	710417114038	Reshin Vince.V	ſ	
31	710417114039	Sandeep .P	8	
32	710417114041	Sebin Joy	ſ	
33	710417114042	Sunny Jacob		
34	710417114043	Surya Prakash .S	9	
35	710417114044	Thabin Saji	8	
36	710417114045	Tilon Jose	8	
37	710417114046	Vetrivel. M	6	
38	710417114047	Vijay.E	7	
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#### DEPARTMENT OF MECHANICAL ENGINEERING

VAME2004 - OVERVIEW OF CFD PROCESS: PRE-PROCESSING, SOLVING,

#### **POST-PROCESSING**

## **MULTIPLE CHOICE QUESTION**

Name	: Moluin Raju
Register No.	: Moluin Raju : 710417114029
Year / Sem	: iv lvin
Academic Year	: 2020-21

- 1. What does geometry mean?
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- b) Measurement of physical objects
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- A) Measurement of pressure

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5. The solution of the equation (  $\frac{\delta u}{\delta u} = \frac{\delta u}{\delta u}$  ) with the boundary conditions  $t u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: a) (  $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 1 + 3 \sin(n \sin x)$  ), ( u(0,t) = 0 ), and ( u(1, t) = 0 ), where ( 0 < x < 1 ) is: b) ( $u(x, 0) = 1 + 3 \sin(n \sin x)$  ), (  $u(0,t) = 0 + 3 \sin(n \sin x)$  )

X

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c) (  $u(x, t) = \sum_{n=1}^{(\inf ty)} \frac{-n2\pi^2 t}{(\sin(n\pi))}$ ) d) (  $u(x, t) = 3 \sum_{n=1}^{(\inf ty)} \frac{-n2\pi^2 t}{(\sin(n\pi))}$ )

6. In a free space, a plane wave with (  $(z \setminus eq 0)$  ) electric field (  $E_i = 40 \setminus cos(10^8 t - beta z) \setminus at_{a}_x$ , \text{V/m} ) is incident normally on a lossless medium (( \varepsilon = 2\varepsilon\_0 ) and ( \mu = 5\mu\_0 )) in the region (  $z \setminus eq 0$  ). The reflected electric field component is: a) (  $-40 \setminus eta_0 \setminus cos(10^8 - frac_{1}_{3}z) \setminus at_{a}_y$ ,  $text{V/m}$  ) b) (  $-9 \setminus eta_0 \setminus cos(10^8 t + frac_{1}_{3}z) \setminus at_{a}_y$ ,  $text{V/m}$  ) c) (  $-1.6 \setminus eta_0 \setminus cos(10^8 t + frac_{4}_{3}z) \setminus at_{a}_y$ ,  $text{V/m}$  ) d) (  $-9 \setminus eta_0 \setminus cos(10^8 t - frac_{4}_{3}z) \setminus bt_{a}_y$ ,  $text{V/m}$  )

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## DEPARTMENT OF MECHANICAL ENGINEERING

## STUDENT FEEDBACK FORM

Name of the value added course: Overview of CFD process. Name of the student: Lokesh. K Register Number: 710417114304 Year / Semester: IV / VIII Batch: 2017 ~ 2021 Course Coordinator: Mr. Prabhu. C Academic Year: 2020 - 2021

Sl.No.	Criteria	Rating				
		Excellent	Good	Average	Satisfactory	Poor
1	Course content		>			
2.	Individual attention	~				
3.	Level of the course		~			
4.	Regularity and knowledge of faculty			$\checkmark$		
5.	Coverage of syllabus	5				
6.	Interaction		5			
7.	Outcome					
	Total	เล	12	ය		
	Remarks	Good				
EXCEI	LENT-5 GOOD-4	AVER	AGE-3	SATISFA	CTORY-2	POOR-1

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Signature of the student





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## DEPARTMENT OF MECHANICAL ENGINEERING

## POST EVENT REPORT

Course code	VAME2004			
Name of the course	OVERVIEW OF CFD PROCESS: PRE- PROCESSING, SOLVING, POST-			
Duration of the course	35 Hours			
Academic year	2020-2021			
Period of the course	15 Days			
Coordinator & Faculty handling the course	Mr. Prabhu C Mr. Hari Prasath R			
Number of the students registered	50			
Number of the students completed	50			
% of students completed the course	100%			
Details of the course	Certainly! The overview of the Computational Fluid Dynamics (CFD) process involves three main stages: pre-processing (geometry creation and meshing), solving (solving governing equations over a meshed model), and post- processing (analyzing predicted physical quantities qualitatively and quantitatively)			

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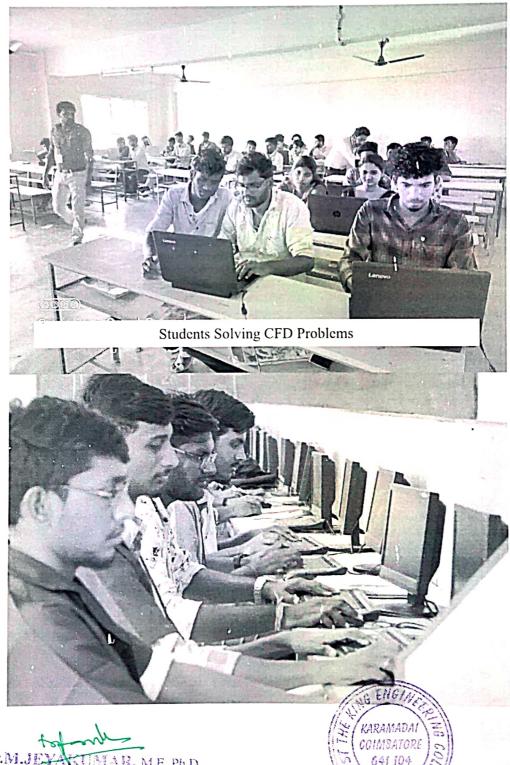




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## **PHOTOS**



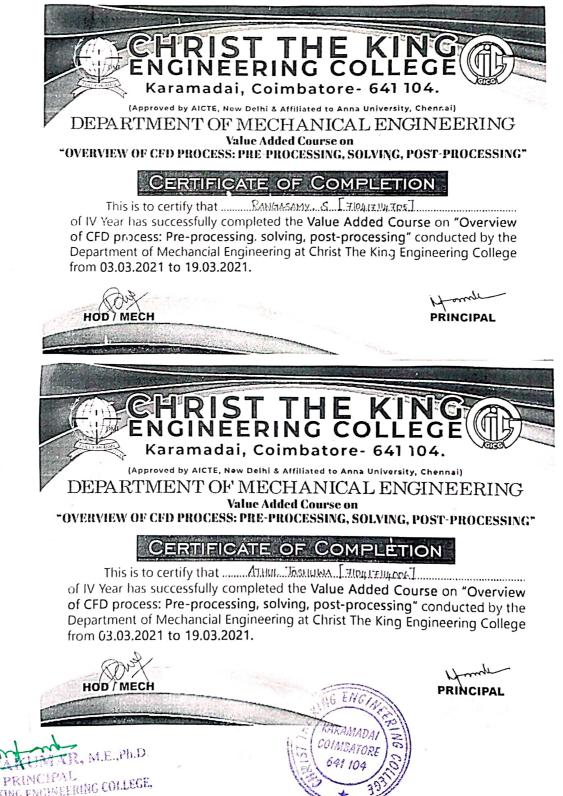
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CERTIFICATE



CHRIST THE KING ENGINEERING COLLEGE, Chikkarampalayani Village, Zaman Matana Jawara Taluk,

Dr.M.JE)