CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering
1.3.3 – proofs

Key Indicator -1.3 Curriculum Enrichment

1.3.2 Number of value-added courses imparting transferable and life skills offered during the last five years

1.3.3Avarage Percentage of students enrolled in the courses under 1.3.2 above

AY 2022-23

Sl No	Name of the value added courses (with 30 or more contact hours) offered during AY 2022-23	Course Code, if any	Year of offering	No. of times offered during the same year	Duration of the course	Number of students enrolled in the year	1.3.3 Number of students who completed the course during the year 2022-23	Proof page no
1	MATLAB for Mechanical Engineers	CBIT/ME V01	Aug-Nov 2022	1	30 hours	9	3	2-16
2	Computational Fluid Dynamics for Automobile and Aviation	CBIT/ME V02	Aug-Nov 2022	1	30 hours	20	16	17-55
3	MATLAB for Mechanical Engineers	CBIT/ME V01	Oct'22 – Feb'23	1	30 hours	32	23	56-90

Title of the value added course:

MATLAB for Mechanical Engineers

Code: CBIT/MEV01

Duration: 30 hrs
(from 19-08-2022 to 11-11-2022)

Target participants: All UG students

Academic year: 2022 - 23

Chaitanya Bharathi institute of Technolgy, Gandipet, Hyderabad
Departement of Mechanical Engineering

Circular

29/07/2022

Sub : Value added courses of 2022-23 odd semester- Announcement.

To enhance the knowledge in various areas beyond curriculum Value added course recommended. In this regard the interested students may register for the same on or before 03-08-2022. The course is scheduled from 19th Aug 2022 to 11th Nov 2022.

The list of courses:

1) MATLAB for Mechanical Engineers(CBIT/MEV01)
2) Computational fluid dynamics for automobile and aviation. (CBIT/MEV02)

For further information contact course coordinators.

Course coordinators:

1) MATLAB for Mechanical Engineers(CBIT/MEV01) : K.Gurubrahmam ,Assistant Professor MED, 9491377882, gurubrahmam_mech@cbit.ac.in
2) Computational fluid dynamics for automobile and aviation. (CBIT/MEV02): Dr Indira Priyadarshini., Assisatnt professor, MED, 9441701652, Priyadarshini_mech@cbit.ac.in

Head
Mechanical Engineering Department

PROFESSOR & HEAD
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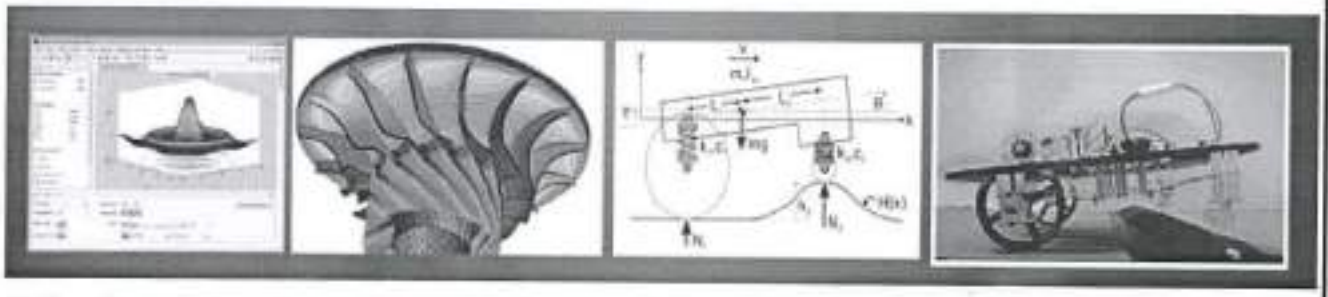
Kokapet | Village, Gandipet, Hyderabad, Telangana-500075 www.cbit.ac.in
COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 43 years

Department of Mechanical Engineering

Value Added Course

On

MATLAB FOR MECHANICAL ENGINEERS (CBIT/MEV01)



Objective of the Course:

MATLAB gives Analyze data both numerically and statistically, easily perform iterations and conditional calculations, Solve complex math problems, Plot and visualize data. Automate a task or calculation.

Introduction:

MATLAB is commercial software and a trademark of The MathWorks, Inc., USA. It is an integrated programming system, including graphical interfaces and a large number of specialized toolboxes. MATLAB is getting increasingly popular in all fields of science and engineering. It provides an interactive environment with hundreds of built-in functions for technical computation, graphics, and animation. Best of all, it also provides easy extensibility with its own high-level programming language. The name MATLAB stands for MATrix LABoratory.

MATLAB's built-in functions provide excellent tools for linear algebra computations, data analysis, signal processing, optimization, numerical solution of ordinary differential equations (ODEs), quadrature, and many other types of scientific computations. Most of these functions use state-of-the-art algorithms. There are functions for 2-D and 3-D graphics, as well as for animation. Also, who cannot do without their Fortran or C codes codes, MATLAB even provides an external interface

to run those programs from within MATLAB. The user, however, is not limited to the built-in functions; can write his own functions in the MATLAB language Once written. these functions behave just like the built-in functions. MATLAB 's language is very easy to learn and to use There are also several optional "toolboxes" available from the developers of MATLAB. These toolboxes are collections of functions written for special applications such as symbolic computation, image processing, statistics. control system design, and neural networks. The list of toolboxes keeps growing with time. There are now more than 50 such toolboxes. The basic building block of MATLAB is the matrix. The fundamental data type is the array. Vectors, scalars, real matrices, and complex matrices are all automatically handled as special cases of the basic data type.

Matlab in fact an industry standard for data acquisition and mathematical modelling. When it comes to mathematical modelling in all Aerospace, Automobile, Control system domain it is an Industry standard. Almost in all the IITs. IISc. universities, students and professors use it for research purposes.

Mechanical Engineers require MATLAB to analyse problems in basic engineering mechanics, vibrations, control system, statistics and dynamics of different circuits. MATLAB is probably the all-rounder tool for simulations, programming, graphs, measurement & automation and statistics for an engineer. Here are some areas where MATLAB and SIMULINK plays a vital role:-

Kinetics, Kinematics and complete dynamic system of Automotive suspensions: – The toolbox consists of functions that deal primarily with homogeneous transforms and their Lie algebra. It has a set of functions for interacting with serial link kinematic structures.

Thermal systems: – Thermodynamics based applications in automotive, aerospace and industrial control Thermolib is the thermodynamic and thermo-chemical tool that seamlessly integrate into the MATLAB and Simulink environment. One of the feature is to calculate real gas behavior based on the Peng-Robinson EOS.

Finite Element Analysis: – FEA deals with the stiffness matrix. Manually assembling the matrix might be hectic and time-consuming MATLAB makes it easier to assemble the stiffness matrix, giving you time to concentrate on other domains.

SIMULINK provides various models such as mechanical, hydraulic, thermal and isothermal liquid models, two phase fluid models, gas models, moist air model etc. One can model the entire control of mechanical system using MATLAB and SIMULINK. With MATLAB 2D, 3D and surface plots can also be created faster. Whether you are a thermal engineer performing auto cycle simulations or an automobile engineer doing vehicle dynamic simulation, MATLAB is easy and can be used to do computational project for every subject you learn. Hence, Mechanical engineers of Design and manufacturing field use MATLAB and Simulink heavily. You would be surprised to know that MATLAB also forms the based for different CAD software as well as designing software just like SOLIDWORKS. As, it is easier to learn and use MATLAB, it is widely accessible to the students in the form of free and paid versions.

Automation, core companies are looking for mechanical engineers who can integrate their technical knowledge with an automation tool. Numerous job opportunities are available for a mechanical engineer specialised in MATLAB. Also, Software companies like Google and Facebook hire Mechanical/Thermal engineers to ensure efficient and safe thermal management of their database and cluster computers in their respective companies.

Industrial Automation and Machinery engineers use Model-Based Design in MATLAB and Simulink to: **Design and test machine controls and supervisory logic**. Run automatic tests on equipment functions. Design artificial intelligence (AI) algorithms for predictive maintenance and operations optimization.

Some capabilities of MATLAB in Mechanical Engineering are:

- Structural Analysis
- Computational Fluid Dynamics
- Thermal Analysis
- Analysis of composite structures
- Industrial Production technology
- Control systems

Industries

Aero/Avlation/Automotive industries working with MATLAB:

MATLAB is extensively used in Defence, Space technology, Aerospace and Automobile industries because of its application in modelling and finite element analysis. It is also used in Mass production industries.

Companies ranging from automotive, banking, and software implement the MATLAB software. The lists of companies in automotive sector using the MATLAB Software are:

- Volvo
- Jaguar
- Mercedes
- BMW

A company from the software sector includes.

- Adobe Photoshop

All the Banking companies which involve crunches of calculations such as Citi Bank, HDFC do implement the concepts indirectly.

Payscale.com survey confirms that the basic mechanical engineer salary with MATLAB skills may vary from **5,00,000–5,80,000** per annum in India while internationally it begins from **$40,000** per annum. The typical MathWorks Software Engineer salary is **₹10,33,333**. Hence, a B-tech degree with a specific MATLAB skill would fetch a lot of job opportunities as well as higher studies opportunities.

Prerequisite:

1. C Programming, Basics of Engineering Mathematics
2. No prior knowledge of Matlab is required. Basic computer literacy is expected.

Course Objectives:

1. To Impart the Knowledge to the students with MATLAB software
2. To provide a working introduction to the Matlab technical computing environment.
3. To introduce students the use of a high-level programming language, Matlab.

Outcome of the course: After completion of course students will be able to

1. Programming knowledge in Research and Development.
2. Themes of data analysis, visualization, and programming.
3. Scientific problem solving with applications and examples from Engineering.

Selection criteria:

- Students will be selected based on their CGPA in 2:1 ratio (20 students per course)
- Students has to give interview
- Based on performance 20 students will be selected.

Modalities of the conduction of course:

- The course of 30 hours planned to conduct during college timings in Library period.
- Interested Students has to apply for the course.
- Students need to submit all assignments and Present real time case study during the course as a project report.
- Certificate will be issued after completion of the course to the students with 80% attendance.

- Topics to be covered:

1. Basics of Matlab and MATLAB Compiler
   The Matlab user interface
   Working with Matlab data types
   Creating matrices and arrays
   Operators and control statements
   Using scripts and functions
   Data import and export
   Using the graphical features
2. Programming with simple examples

CDIT/MEV01 **With Effect from the Academic Year 2022-2023**

MATLAB FOR MECHANICAL ENGINNERS

Instruction (Periods per week) 2 Periods
Duration of End Examination 3 Hours

Module-1	Basics of MATLAB, MATLAB windows, On-line help, Input-output, File types, General commands should remember. Add, multiply, and exponentiation numbers, use trigonometric functions; and control screen output with format.-	2H
Module-2	Creating and Working with Arrays of Numbers, Creating and Printing Simple Plots, Write and execute a script file, Write and execute a function file.-	3H
Module-3	Arrays and Matrices, Working with Anonymous Functions, Symbolic Computation, Importing and Exporting Data, Working with Files and Directories, Publishing Reports.-	2H
Module-4	Matrices and Vectors, Matrix and Array Operations, Character strings, Command-Line Functions,-	3H
Module-5	Using Built-in Functions, Saving and Loading Data, Programming in MATLAB: Scripts and Functions: Script Files, Function Files	- 3H
Module-6	Applications: Linear Algebra, Curve Fitting and Interpolation, Numerical Integration, Ordinary Differential Equations, Nonlinear Algebraic Equations.-	2H
Module-7	Graphics: Basic 2-D Plots, Using subplot for Multiple Graphs, 3-D Plots, 3-D Surface Graphics	2H

List of the Exercises-13H

1) Figure 1 shows a frame in which the structural members support the 5 kN load. The load may be applied at any angle α (– 90° to + 90°). The pins at A and B need to be designed to support the maximum force transmitted to them. Write a MATLAB program to plot the forces at A and B as a function of α and find their maximum values and corresponding angles α.

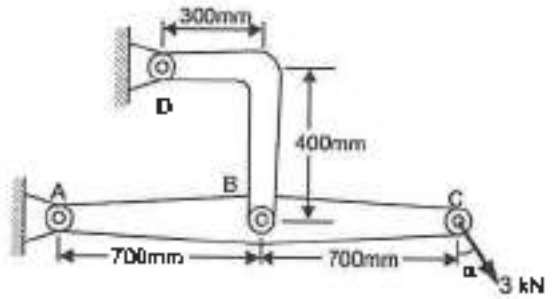


Figure. 1

2) In figure 2, the spring is unstretched when α = 0 and k is the spring constant. Write a MATLAB program to compute and plot the mass m corresponding to equilibrium as a function of α for values of α from 0° to 90°. Find the value of α corresponding to equilibrium m=2.5kg. Given R = 210 mm,d = 50 mm and k = 1.2 kN/m.

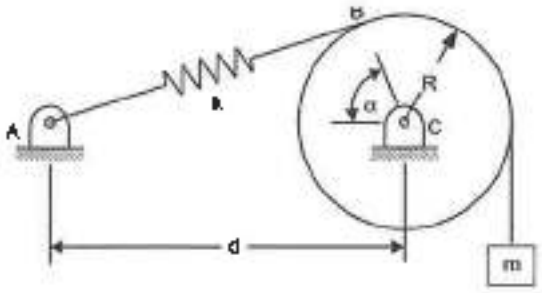


Figure. 2

3) Figure 3 shows a crank shaft mechanism where a couple M is applied to the crank AB to maintain the equilibrium of the system. The force applied to the system is F. Write a MATLAB program to plot the ratio of M/F as a function of crank angle α from 0 to 180 degrees. Given a = 50 mm and A = 150 mm. Determine the value of crank angle α for which the ratio M/F is maximum and the corresponding value of M/F.

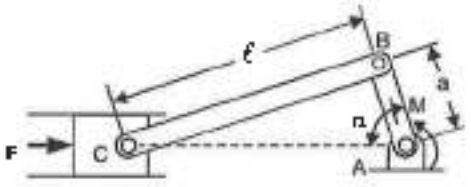


Figure 3

4) Figure 4 shows axle pulley system where the coefficient of friction between cable ABCD and the pulley varies between 0 and 0.60. Write a MATLAB program to determine, (a) the values of α for the system to remain in equilibrium (b) the reactions at A and D (c) Plot α as a function of the coefficient of friction.

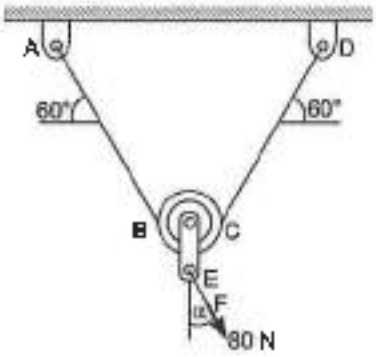


Figure 4

5) Figure 5 shows a safety bumper placed at the end of a racetrack to stop out-of-control vehicles. The force that the bumper applies to the vehicle is given by $F = Kv^3 (x + 1)^3$ where K = 32 kg-s/m5 (a constant) x = displacement of the front edge of the bumper v = velocity of the front edge of the bumper. A vehicle of mass 2000 kg hits the bumper at a speed of 100 km/h. Write a MATLAB program to determine and plot the velocity of the vehicle as a function of x for $0 \le x \le 5$m.

Figure 5

6) A 5 kg block is attached to a cable and to a spring as shown in Fig. 6. The constant of the spring is k = 3 kN/m and the tension in the cable is 30 N. When the cable is cut,

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Hyderabad-500 075, Telangana

(a) derive an expression for the velocity of the block as a function of its displacement x, (b) determine the maximum displacement x m and the maximum speed v m, (c) plot the speed of the block as a function of x for $0 \leq x \leq x_m$.

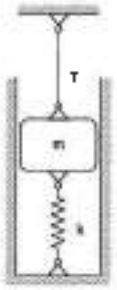

Figure 6

7) Figure 7 shows the slider crank mechanism. Write a MATLAB program that calculates and plots the position, velocity and acceleration of the piston for one full revolution of the crank. Assume that the crank is rotating at a constant speed of 550 rpm. Given radius of crank = 125 mm and radius of crank shaft = 250 mm.

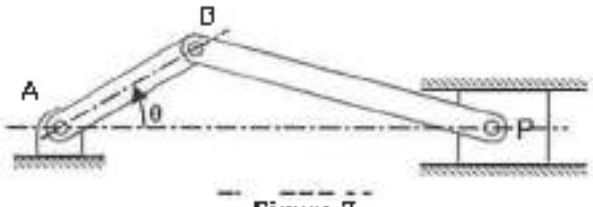

Figure 7

8) Write a MATLAB script for plotting (a) the non-dimensional response magnitude for a system with harmonically moving base shown in Fig. 8 (b) the response phase angle for system with harmonically moving base.

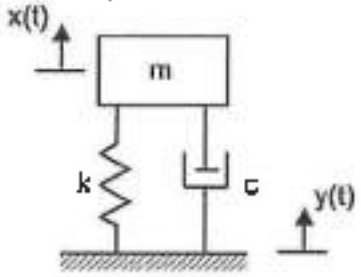

Figure 8

9) Rectangular fin of uniform cross section, with width of 18mm and thickness of 5mm and length of 100 mm is attached to the wall with surface temperature of 320 °C. The fin is made of material with thermal conductivity of 50 w/mk. The ambient air temperature is 24°C and the convection heat transfer coefficient of 15W/m k.

1- (**Plot**) the temperature variation for the following boundary condition

a- Infinitely long fin, b- Adiabatic fin tip, c- Convection from the fin tip.

2- Find the temperature at the midpoint of the fin length

3- Find the heat transfer rate, 4- Find the fin efficiency

VAC-MATLAB FOR MECH ENGINEERS-Attendance

VAC-MATLAB FOR MECH ENGINEERS-Attendance			25-09-2022	1-8-2022	4-8-2022	18-09-2022	13-10-2022	21-10-2022	27-10-2022	4-11-2022	14-11-2022	15-11-2022	18-11-2022	Total classes-31	
			0	1	1	1	1	1	1	1	1	0	1	10	
1	1601-19-736-075	CHINNAM KRISHNA PERI	A	A	A	A	A	A	A	A	A	A	A	0	-
2	1601-19-736-114	VAISHNAVI GUGULOTHU	1	1	A	1	1	A	1	1	1	1	1	27	
3	1601-19-736-313	NIRMITA NAIK	A	A	A	A	A	A	A	A	A	A	A	0	-
4	1601-19-736-327	SHARATH CHANDRA MALOTH	0	1	A	A	A	A	A	0	A	A	A	0	-
5	1601-19-736-085	NAGAVARUN SAMALA	1	1	1	A	A	A	A	1	1	1	A	19	-
6	1601-19-736-329	SAMEERA VODELA	A	A	A	A	A	A	A	A	A	A	A	0	-
7	1601-19-736-092	ROHIT RAHUL GODSE	A	A	1	1	1	1	1	1	1	1	1	27	
8	1601-19-736-737	VITESH BHARADWAJ MALLIBHOT	1	A	1	1	A	1	1	1	1	1	1	27	
9	1601-19-736-095	LAKSHMI PRASANNA KATTIPOJU	1	1	1	1	1	1	1	1	1	1	1	15	-

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Kokapet(Village), Gandipet, Hyderabad, Telangana-500075. www.cbit.ac.in

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

A VALUE ADDED COURSE

on

MATLAB FOR MECHANICAL ENGINEERS

Course completion certificate

This is to certify that Mr./Ms./Mrs *Rohit Rahul Godse*, Roll No: *160119736098*, has successfully completed value added course on MATLAB FOR MECHANICAL ENGINEERS, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

K Gurubrahmam
(Assistant Professor
Coordinator)

Prof.P.V.R.Ravindra Reddy,
(HOD of Mech. Engg, CBIT)

Prof.P.Ravinder Reddy
(Principal)

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A VALUE ADDED COURSE

on

MATLAB FOR MECHANICAL ENGINEERS

Course completion certificate

This is to certify that Mr./Ms./Mrs *Gugulothu Vamshi*, Roll No: *160119736114*, has successfully completed value added course on MATLAB FOR MECHANICAL ENGINEERS, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

K Gurubrahmam
(Assistant Professor
Coordinator)

Prof.P.V.R.Ravindra Reddy,
(HOD of Mech. Engg, CBIT)

Prof.P.Ravinder Reddy
(Principal)

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A VALUE ADDED COURSE

on

MATLAB FOR MECHANICAL ENGINEERS

Course completion certificate

This is to certify that Mr./Ms./Mrs *Mallibhat Vitesh Bharadwaj*, Roll No: *160119736117*, has successfully completed value added course on MATLAB FOR MECHANICAL ENGINEERS, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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Coordinator)

Prof.P.V.R.Ravindra Reddy,
(HOD of Mech. Engg. CBIT)

Prof.P.Ravinder Reddy
(Principal)

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Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana

Title of the value added course:

MATLAB for Mechanical Engineers

Code: CBIT/MEV01

Duration: 30 hrs

(from 19-08-2022 to 11-11-2022)

Target participants: All UG students

Academic year: 2022 – 23

Outcome of the course:

This course will be useful to pursue higher studies and will be helpful for placements.

Title of the value added course:

Computational Fluid Dynamics for Automobile and Aviation

Code: CBIT/MEV02

Duration: 30 hrs

Target participants: All UG students

Academic year: 2022 - 23

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2) Computational fluid dynamics for automobile and aviation. (CBIT/MEV02)

For further information contact course coordinators.

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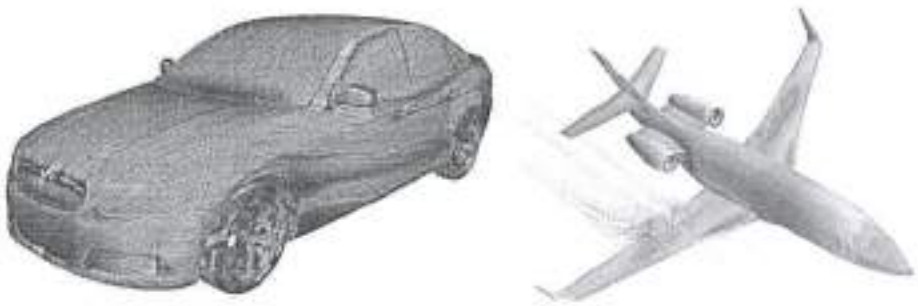
Department of Mechanical Engineering

Value Added Course

On

Computational Fluid Dynamics for Automobile and Aviation (CBIT/MEVO2)



Objective of the Course:

CFD gives insights into flow pattern that are difficult, expensive or impossible to study using traditional techniques (Experimental) techniques.

Introduction:

From the 1960s onwards the aerospace industry has integrated CFD techniques into the design, R&D and manufacture of aircraft and jet engines. More recently the methods have been applied to the design of internal combustion engines, combustion chambers of gas turbines and furnaces. Furthermore, motor vehicle manufacturers now routinely predict drag forces, under-bonnet air flows and the in-car environment with CFD. Increasingly CFD is becoming a vital component in the design of industrial products and processes.

Wind-tunnel testing is typically limited in the Reynolds number it can achieve, usually short of full scale. Very high temperatures associated with coupled heat transfer fluid flow problems are beyond the scope of many experimental facilities. This is particularly true of combustion problems where the changing chemical composition adds another level of complexity.

There are several unique advantages of CFD over experiment-based approaches to fluid systems design:

(i)substantial reduction of lead times and costs of new designs

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(ii) ability to study systems where controlled experiments are difficult or impossible to perform (e.g. very large systems)

(iii)ability to study systems under hazardous conditions at and beyond their normal performance limits (e.g. safety studies and accident scenarios)

(iv) practically unlimited level of detail of results

(iii) provides more detailed and comprehensive information.

(iv) is increasingly more cost-effective than wind-tunnel testing.

(v) produces a lower energy consumption.

Industry Growth

the investment costs of a CFD capability are not small, but the total expense is not normally as great as that of a high-quality experimental facility.

- The growth of the market can be attributed to rapid innovations in the aerospace and aeronautical and automobile industries.
- The global computational fluid dynamics market attained a value of USD 1.8 billion in 2020. The computational fluid dynamics (CFD) market share is expected to increase by USD 606.76 million from 2022 to 2025, and the market's growth momentum will accelerate at a CAGR of 12%.
- 37% of the market's growth will originate from Europe, Evolving opportunities with **Altair Engineering Inc.**, and **ANSYS Inc** Market growth will be faster than the growth of the market in other regions.

Industries

Aero/Aviation/Automotive industries working with CFD:

Defence Research and Development Organisation (DRDO) Labs like, Advanced Systems Laboratory (ASL). Defence Research & Development Laboratory (DRDL), Advanced Numerical Research & Analysis Group (ANURAG), Gas Turbine Research Establishment (GTRE), Naval Science & Technological Laboratory (NSTL), Hindustan Aeronautics Limited(HAL), Aeronautical Development Agency (ADA), National Aerospace Limited (NAL), Indian Space Research Organisation (ISRO) etc., **BHEL.**

MNCs like SIEMENS, GE, Altair Engineering **Inc.**, ANSYS Inc., Autodesk Inc., COMSOL AB, Convergent Science Inc., and Dassault Systemes SE, ESI Group, Hexagon AB, PTC Inc., and Siemens AG, Tech Mahindra, Wipro, HCL, GREAVES TECHNOLOGIES **LIMITED** , Caterpillar Inc, Intel, Infotech etc.,

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Modalities of the conduction of course:

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- Students need to Submit all assignments and Present real time case study during the course as a project report.
- Certificate will be issued after completion of the course to the students with 80% attendance.

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CBIT/MEV02 **With Effect from the Academic Year 2022-2023**

Computational Fluid Dynamics for Automobile and Aviation

Instruction (Periods per week) 2 Periods
Duration of End Examination 3 Hours

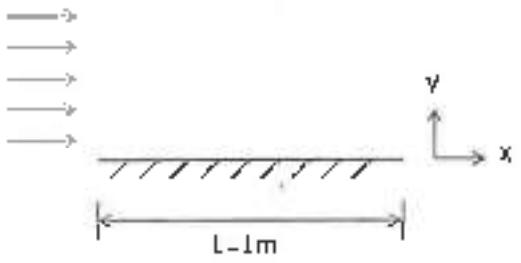
Outcome of the course: After completion of course students will be able to

1. Differentiate laminar and turbulent flow problems.
2. Analyze fluid flow distribution IC engine components.
3. Evaluate the importance and effect of angle of attack on aerofoil
4. Calculate the mach number, shock angle, pressure coefficient along the wedge and drag coefficient.
5. Present case studies related to aero and automobile industry

List of learning modules

Module No.	Topic	Duration (Hrs)
Module-1	Introduction; Governing equations used in CFD, Introduction to ANSYS Fluent, Study of the numerical solution to a Laminar & Turbulent flows	5
Module-2	Study of flow distribution in IC engine components like combustion chamber, exhaust manifold etc.	5
Module-3	Analyze effect of angle of attack on aerofoil NACA 0012 (Compressible Flow)	5
Module-4	Simulation of Supersonic Flow Over a Wedge to calculate the Mach Number, shock angle, pressure coefficient along the wedge and drag coefficient.	5
Module-5	Case studies based on Aerospace industrial problems.	5
Module-6	Case studies based on Automobile industrial problems.	5

IC engine Cylinder wall flow analysis



Consider a fluid flowing across a flat plate, as illustrated above. The plate length is 1 m. Hight is 0.5 m. The incoming fluid is flowing in the x-direction with a velocity of 1 m/s. The density of the fluid is 1 kg/m^3 and the viscosity is 1 x 10 ^(-4) kg/(m-s). Obtain the velocity and pressure distribution when the Reynolds number based on the plate length is 10,000.

Step 1: Pre-Analysis and Start-Up

Pre-Analysis

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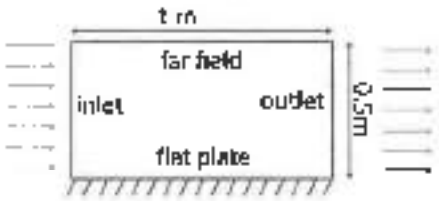


Start ANSYS FLUENT

- **Start> All Programs> Ansys 15 > Workbench**

Step 2: Geometry

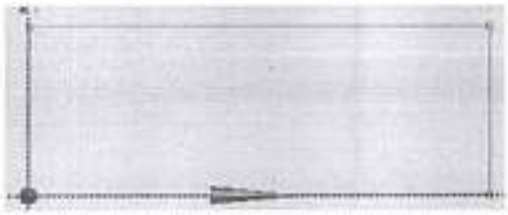
- **Fluid Flow(FLUENT) Project Selection** .
- **Left** click (and hold) on **Fluid Flow (FLUENT)**, and drag the icon into the empty space in
- **Advance Geometry Options**, change the **Analysis Type** to 2D

Launch Design Modeler

- In the **Project Schematic**, double click on **Geometry**

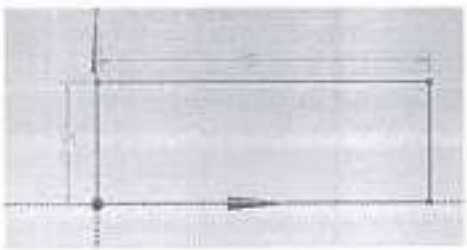
Creating a Sketch

- **XYPlane.** Under **Tree Outline**,
- , select **XYPlane, > Sketching > Details View. > Sketching Toolboxes.**
- select **Rectangle.** In the **Graphics** window, create a rough rectangle by clicking once on the origin and then by clicking once somewhere in the positive XY plane.



Dimensions

- **Sketching Toolboxes** > select **Dimensions** tab, use the default dimensioning tools.



Surface Body Creation

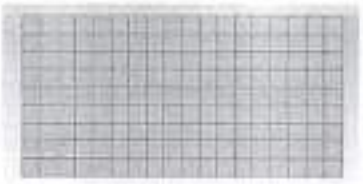
- **(Click)Concept > Surface From Sketches**

- **SurfaceSK1**. Under **Details View**, select **Sketch1** as **Base Objects**. Finally, click **Generate** to generate the surface.

Step 3: Mesh

Launch Mesher

- **Workbench Project Page**, then **(Double Click) Mesh.**
- click on **Mesh**, then click on **Update** as shown in the image below.



Mapped Face Meshing

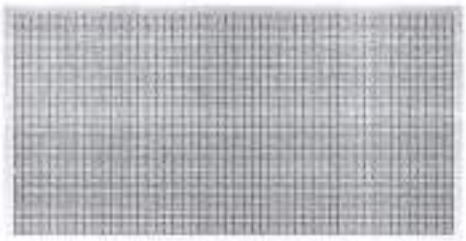
- **Mesh Control > Mapped Face Meshing** as can be seen below.

- **(Click) Apply** in the **Details of Mapped Face Meshing**
- Now, generate the mesh by clicking **Update.**

Edge Sizing

- **(Click) Mesh Control > Sizing**

- **(Click) Edge Selection Filter.** . Then hold down the "Control" button and then click the bottom and top edge of the rectangle. Both sides should highlight green. Next, hit **Apply** under the **Details of Sizing** table as shown below.
- Now, set **Type** to **Number of Divisions** as shown in the image below. Then, set **Number of Divisions** to 50 as shown below.



Edge Sizing Biasing

- **Bias Factor** to 70 as shown below. The **Bias Factor** is defined in this case to be the ratio of the longest division and the shortest division. That is, the last division will be seventy times longer than the length of the first division. **Click) Mesh Control > Sizing > Type** to **Number of Divisions** and set **Number of Divisions** to 60. > **Behavior** to **Hard** and set **Bias Type**
- set the **Bias Factor** to 70.> click **Update** to generate the new mesh

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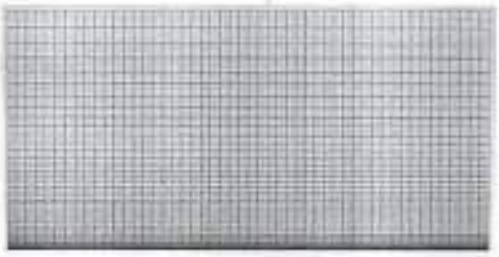

Create Named Selections

- **(Click) Edge Selection Filter,** . Then click on the left side of the rectangle and it should highlight green. Next, right click the left side of the rectangle and choose **Create Named Selection** as shown below.

- **Create Named Selection**. Enter "inlet" and click **OK**. as shown below.

Workbench Project Page and click the **Update Project** button, Update Project .

Step 4: Setup (Physics)

Launch Fluent

Double click on **Setup**

- FLUENT Launcher appears change the options to "Double Precision", and then click OK

Define Solver Properties

- **Models > Energy-Off > Edit...,**
- **Models > Viscous - Laminar > Edit...,**
- By default, the Viscous Model options are set to **laminar**

Define Material Properties

- **(Click) Materials > Fluid > Create/Edit...**
- **Density** to 1kg/m^3 (constant)
- **Viscosity** to 1e-4 kg/(ms) (constant)
- Click **Change/Create**. Close the window.

Define Boundary Conditions

Inlet Boundary Condition

- **(Click) Boundary Conditions > inlet > Edit...**
- **Boundary Condition Type > velocity-inlet.**
- **Velocity Specification Method to Components**
- **X-Velocity (m/s)** to 1 m/s, as shown below.

- Then, click **OK** to close the **Velocity Inlet** menu.

Outlet Boundary Condition

- **(Click) Boundary Conditions > outlet > Edit**
- **Boundary Condition Type > pressure-outlet.**

Plate Boundary Condition

- **Boundary Condition Type > to wall**

Far-Field Boundary Condition

- **Boundary Condition Type > symmetry,**

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- symmetry boundary conditions sets the velocities normal to the boundary equal to zero.

Step 5: Solution

- **Solution Methods > Momentum > Second Order Upwind**

Set Convergence Criteria

- **(Click) Monitors > Residuals > Edit...,**

- Lastly, click **OK** to close the **Residual Monitors** menu.

Set Initial Guess

- **Solution Initialization > Compute from > inlet**
- click the **Initialize** button, Initialize. This completes the **initialization** process.

Iterate Until Convergence

- **Run Calculation > Number of Iterations** to 1000, as shown in the image below.

Step 6. Results

- Double click on Results from the Workbench Window to launch CFD-Post.

Velocity Vectors

- **Locations to symmetry 1**. Click on **Apply** to display the velocity vectors.

The velocity vectors will be displayed in the view window.

Pressure Contour

Insert > Contour. Name it Pressure contour.

Click on Apply to view the contour.

Outlet Velocity Profile

insert > location > line. Name it "Outlet"

Airfoil

Problem Specification

In this tutorial, we will show you how to simulate a NACA 0012 Airfoil at a 6 degree angle of attack placed in a wind tunnel. Using FLUENT, we will create a simulation of the experiment. Afterwards, we will compare values from the simulation and data collected from experiment.

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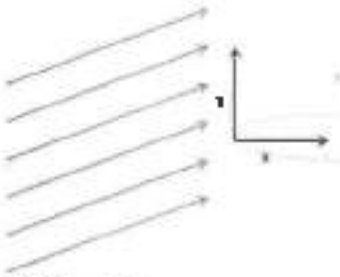


Pre-Analysis & Start-Up

Boundary Conditions

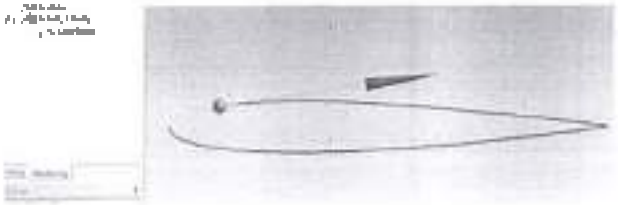
1. Geometry

Download the Airfoil Coordinates

Launch Design Modeler

Airfoil

- **Concept > 3D Curve.** In the Details View window,
- click **Coordinates File** and select the ellipsis ⊐ to browse to a file.
- click Generate to create the curve. Click to get a better look at the curve.



- **Concepts > Surfaces From Edges.**
- Click anywhere on the curve you just created, and
- select **Edges > Apply** in the Details View Window. Click Generate to create the surface.

Create C-Mesh Domain

- Click to create a new coordinate system. In the Details View window,
- select **Type > From Coordinates.** For **FD11, Point X,** enter 1.

- Click Generate to generate the new coordinate system.
- In the Tree Outline Window, select the new coordinate system you created (defaulted to **Plane 4**), then click to create a new sketch.
- click the **Sketching** tab to bring up the sketching window.

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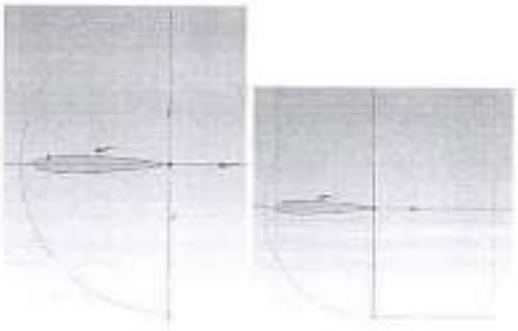
- Click Arc by Center .
- The first click selects the center of the arc, and the next two clicks determine the end points of the arc. We want the center of the arc to be at the tail of the airfoil. Click on the origin of the sketch, making sure the P symbol is showing

For the end points of the arc, first select a point on the vertical axis above the origin (a C symbol will show), then select a point on the vertical axis below the origin. You should end up with the following:



To create the right side of the C-Mesh domain,

- click Rectangle by 3 Points .
- Click the following points to create the rectangle in this order - where the arc meets the positive vertical axis, where the arc meets the negative vertical axis, then anywhere in the right half plane. The final result should look like thisabove fig.

Now, we need to get rid of necessary lines created by the rectangle.

- Select **Modify** in the Sketching **Toolboxes** window,
- then select Trim .
- Click the lines of the rectangle the arc collinear with the positive and negative vertical axises. Now,
- select the **Dimensions** toolbox to dimension the C-Mesh domain.
- Click Radius , followed by the arc to dimension the arc. Assign the arc a value of 12.5. Next,
- select Horizontal .
- Click the vertical axis and the vertical portion of the rectangle in the right half plane. Also assign the horizontal dimension a value of 12.5.
- **Concept > Surface From Sketches.**
- Click anywhere on the sketch, and select **Base Objects > Apply** in the Details View Window. Also,
- select**Operation > Add Frozen.**
- click Generate .

The final step of creating the C-Mesh is creating a surface between the boundary and the airfoil.

- **Create > Boolean.**
- **Operation > Subtract.**
- **Target Bodies > Not selected.**
- select the large C-Mesh domain surface, then click **Apply.**

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- Repeat the same process to select the airfoil as **the Tool Body**. When you have selected the bodies, click Generate

Create Quadrants

- break up the new surface into 4 quadrants;
- select **Plane 4** in the **Tree Outline** Window, and click .
- Open the sketching menu, and select Line . Draw a **line** on the vertical axis that intersects the entire C mesh. **Trim** away the lines that are beyond the C Mesh, and you should be left with this:

- **Concepts > Lines from Sketchs.** > click **Base Objects > Apply**, followed by Generate Now that you have created a vertical line, create a new sketch and repeat the process for a horizontal line that is collinear to horizontal axis and bisects the geometry.
- **Tools > Projection.** Select **Edges** press **Ctrl** and select on the vertical line we drew (you'll have to select both parts of it), then press **Apply**. Next, select **Target** and select the C-Mesh surface, then click **Apply**.
- Once you click Generate, you'll notice that the geometry is now composed of two surfaces split by the line .Repeat this process to create 2 more projections: one projection the line left of the origin onto the left surface, and one projecting the right line on the right surface. When you're finished, the geometry should be split into 4 parts.

2. **Mesh**

Mapped Face Meshing

- **Mesh Control > Mapped Face Meshing.** Making sure the face selection filter is selected ,
- **Geometry > Apply**. Next, select

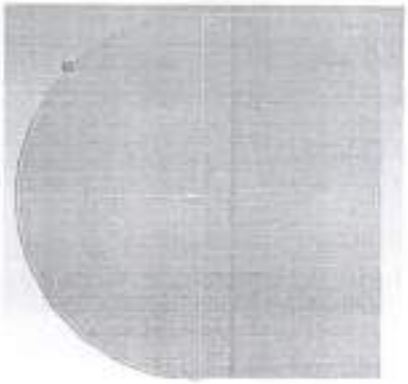
Edge Sizing

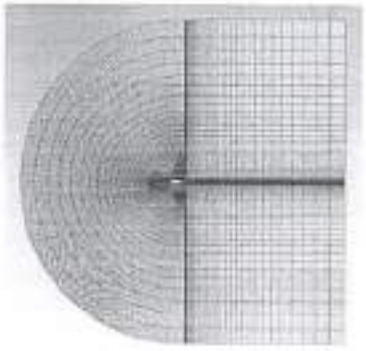
- **Mesh Control** > **Sizing**. Next, click the edge selection filter .
- Select the following 4 edges buy holding **Ctrl** and using the left mouse button:

Geometry > Apply. Next, select **Type > Number of Divisions**. Change the **Number of Divisions** to 50.

- Select **Behavior > Hard**. We also want the mesh to have a bias, so select the first bias type: **Bais** > ----- — - -. and give the edge sizing a **Bias Factor** of 150. The Edge sizing should now look like this:
- Create a new edge sizing with the same parameters, but choose the 4 remaining straight edges (see figure below). The number of divisions will still be 50, but now will be selecting a different biasing type by selecting the second Bias option: **Bias** > - . — .....**.** Again, set the **Bias Factor** to 150

third edge sizing, and select the rounded edges as the geometry> **Type > Number of Divisions**, > **Number of Divisions** to 100 >**Behavior > Hard**. This time, we will not bias the edges.





- **Mesh > Generate** to generate the mesh. It should look like this.

Named Selections

3. Setup

Launch the Solver

Select the Solver

Click **OK** to launch Fluent.

- **Problem Setup > General**. Under Solver, select **Density-Based.**

Models and Materials

- **Problem Setup > Models > Viscous-Laminar**. Then press **Edit**..
- **Inviscid** and press**OK**.
- click **Problem Setup > Materials > (double click) Air.**
- Under Properties, ensure that density is set to **Constant** and enter 1 kg/m^3 as the density. Click **Change/Create** to set the density.

Boundary Conditions

Inlet

- **Problem Setup > Boundary Conditions.**
- **Velocity Specification Method > Components.**
- Specify **X-Velocity** as 0.9945 m/s and **Y-Velocity** as 0.1045 m/s. press **OK**

Outlet

- Select **Outlet**
- **pressure-outlet:** if it didn't, select it. Click **Edit,**
- **Gauge Pressure** is defaulted to 0.

Airfoil

In the Boundary Conditions window, look under Zones and

- select **airfoil**. Select **Type > Wall** if it hasn't been defaulted.

Reference Values

- Problem Setup > Reference Values. >**Compute From** > Inlet.

Solution

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Methods

- Solution > Solution Methods> Second Order Upwind.

Monitors

- **Solution > Monitors.** In **Monitors.** Select **Residuals – Print, Plot** and press **Edit.** In the Residual Monitors Window. we want to change all of the **Absolute Criteria** to 1e-6.

Initial Guess

- **Solution > Solution Initialization. > Compute From > Inlet.** >clicking **Initialize.**

Solve

- Solution > Run Calculation. Change Number of Iterations to 5000. >check Calculate.

6.Results

Velocity

- Results > **Graphics and Animations.** > select **Vectors**and clies **Set Up...**
- **Vectors of > Velocity, Color by > Velocity,** and set the second box as **Velocity Magnitude.** To see the velocity vectors. press **Display.**

Turbulent Flow through a Nozzle

Problem Statement:

Consider a convergent-divergent (CD) nozzle with circular cross section. Let that area vary as a function of the length of the nozzle. Since the area is circular. axisymmetric flow can be assumed and only the upper portion will be modeled for simplification purposes.

Problem Setup—Models:

Under Models

- Double click Energy and put a checkmark thus turning it on.
- Press Ok. It is important to consider the energy equation since we are dealing with compressible flow and we are interested in temperature effects.
- The energy equation now will be calculated alongside the continuity and momentum ones.

Since the Quasi-One dimensional flow approach is assumed for analysis and validation in this tutorial the flow is assumed to be inviscid. Under Models, double click Viscous and select Inviscid.

Problem Setup—Materials:

Underneath Materials, under Fluid double

- Click Air. Under Properties

Next to Density specify Ideal Gas. Since in compressible flow the density is not constant, the value can be seen to be blank. Air is analyzed as an ideal gas. Press Change/Create

Problem Setup—Boundary Conditions:

- Since the fluid flow is assumed to be air as an ideal gas the pressure must be expressed as an absolute pressure.
- Click on Operating Conditions and it can be seen that by default the Operating Pressure (gauge pressure) is set at 101,325 Pa or 1 atm.

Make it equal to 0 and press OK

Change the **Axis zone to type Axis** (the problem has already been specified as Axisymmetric in the Problem Setup—General).

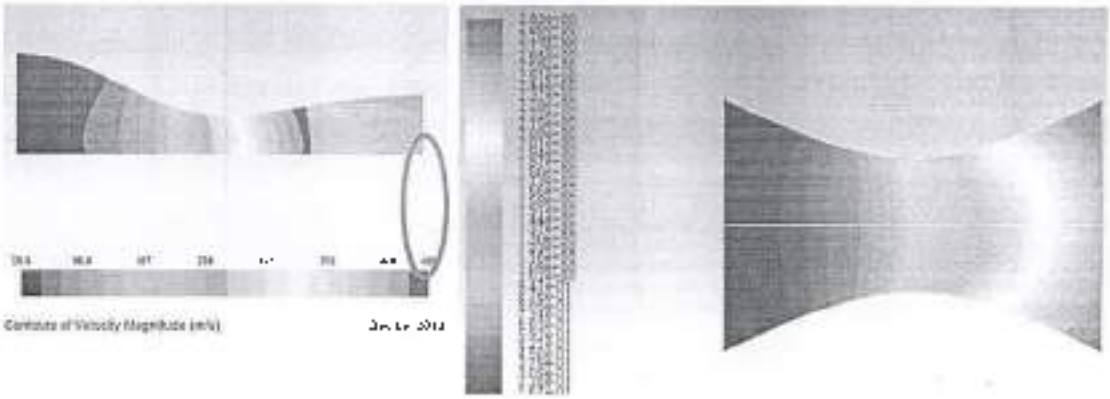
- Verify that the **wall zone is of type wall, the inlet zone is of type pressure inlet,** the **outlet zone if of type pressure outlet** and **the interior zone is of type interior.**

Double click on the outlet zone and enter 101 325 Pa as the outlet gauge pressure

- In the Thermal tab specify the backflow total temperature as 296.375 K. Refer to the problem statement for the calculations performed to obtain those values. Press OK.

Problem Setup—Boundary Conditions:

- Double click on the inlet zone.
- Enter 140.639 Pa as the Total Gauge Pressure, P.
- Specify 135.100 Pa as the Initial Gauge Pressure, P_s (stagnation pressure).
- Refer to the problem statement for the manner in which the two values were obtained
- Set the total temperature in the thermal tab to equal to 296.375 K (ref. to problem statement for calculation).
- **Problem Setup—Reference Values:**
- Set the reference values to be computed from the inlet. Verify the values for temperature and velocity among others make sense. It can be seen there are small variation for the temperature (it was chosen as 293K at the inlet) and the velocity (it was computed as 52.362 m/s at the inlet, ref. to Problem Statement Section).



MACH NUMBER

- The shock inside the nozzle can be clearly seen (circled region). Vast velocity difference is exhibited on each end of the shock.

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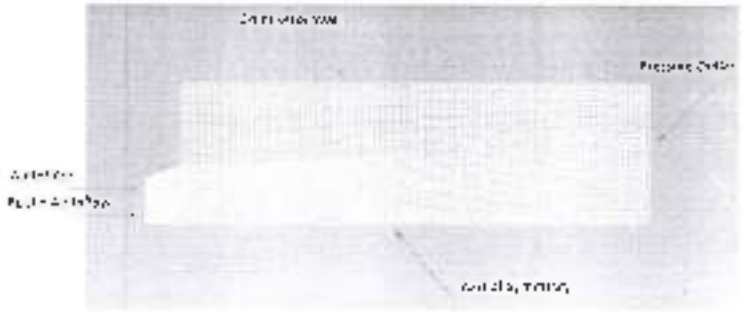
Study of Premixed Combustion

The non-premixed combustion model solves transport equations for conserved scalars and mixture fractions. The amounts of chemical species present are derived from the predicted mixture fraction distribution present in the precomputed PDF tables.These tables are generated by knowing the species that can be present, as well as the inflow conditions and properties of the mixture. For the premixed combustion component which will be solved at simulation runtime, the Zimont turbulent flame speed model includes the laminar flame speed (which determines the chemistry of the system) and the flame front evolution due to turbulence. The assumption to use this model is that the turbulence lengthscale in the flame is smaller than the flame thickness (Karlowitz number Ka > 1) where $Ka = \frac{(\nu\varepsilon)^{1/3}}{(U_{laminar\,flame\,speed})^2}$

Combining these two models is straightforward. The reaction progress variable c is used to track the location of the flame, called the flame front. Before (to the left of) the flame front at c=0, the mixture is unburnt, and the mass fractions and other variables are computed using mixture the precomputed mixture fraction PDFs. Inside the flame, a combination of the two models is used. In the burnt area (to the right of the flame at c=1), the equilibrium mixture fraction is computed.This method is typically limited to combustion systems that only contain 2 inflow streams. Using swirl conditions on one of the streams is useful as it promotes mixing of the two streams; reducing problems with flame initialization and extinction.The turbulence model that will be used is the 2 equation k-ε model, described in detail in the Turbulent Jet tutorial pre-analysis.



The fuel (CH_4) and air mixture has an equivalence ratio of 0.8, defined in the Physics Setup. It is injected at T = 300K with an axial velocity of 5m/s and swirl velocity (θ direction) of 30m/s. The air inflow is at T = 650K and is injected at 10m/s axially, with no swirl. This case is axisymmetric and so the physical combustion chamber is assumed to be cylindrical; rotated about the axis of symmetry. The outflow is the pressure outlet at atmospheric pressure.

Mesh: The mesh was originally created in inches. Click on "Scale" under the Mesh options then select "in" in the drop down box called "Mesh Was Created In", then click "Scale" and close the dialogue box.

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Physics Setup:General: In the General tab, select "Axisymmetric Swirl" in the 2D space type. Keep the solver type as Pressure based to allow the premixed combustion model to be used.

Models: In the Models tab, double click on the Viscous option to change it from Viscous-Laminar to "k-ε (2 eqn)". Do not change any other parameters in the viscous dialogue box. Click "Ok" and close the dialogue box.

Materials:In the Materials section, select the material Mixture, and click "Create/Edit". Note how Fluent has pre-selected the material as a mixture, and computes the density based on the PDF. Leave these pre-selected options. Click "Close".

Patch this region by going to Solution Initialization, and click "Patch". Select "Progress Variable" as the variable, and patch the region that you just marked by clicking "Patch". Close the dialogue after patching. Now go back to Solution Controls and click "Equations". Reselect the PDF and Premixed Combustion options so that all options are highlighted and will be solved for. Press OK. In Solution Methods, make sure that all solvers (Momentum, Swirl Velocity, and Turbulent Kinetic Energy) are set to a second order solver scheme.

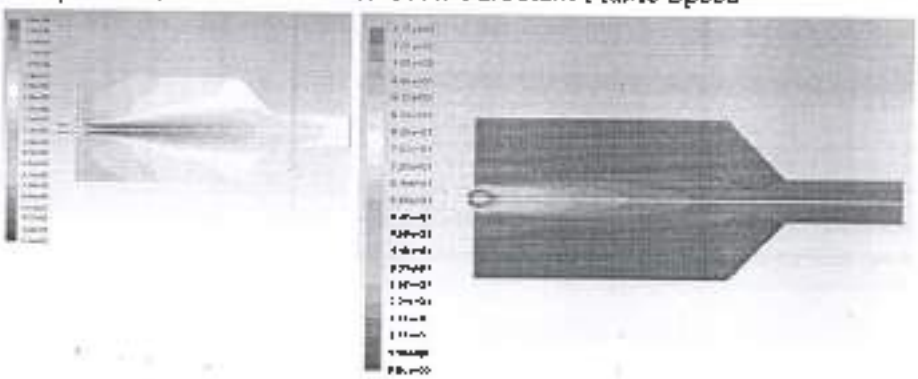
Go to Run Calculation. Press "Calculate". Allow the solution to converge (convergence criterion being that the residuals are all at least 1E-3 or smaller).

. Create contours of:

Stream Function

Progress Variable (called Reaction Progress)

Temperature, Mass Fraction of CH4, Turbulent Flame Speed



Temperature and velocity contours

Wedge with supersonic stream

Problem Specification A uniform supersonic stream encounters a wedge with a half-angle of 15 degrees as shown in the figure below. The stream is at the following conditions:

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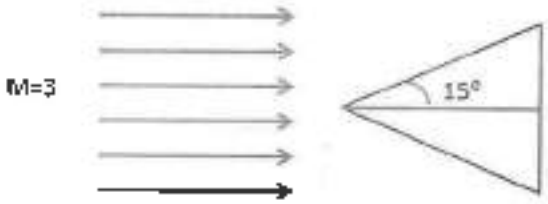


Mach Number $M_1 = 3$

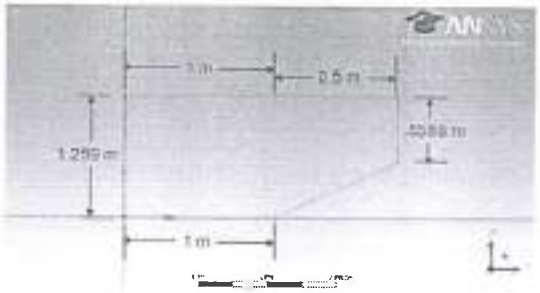
Static Pressure $p_1 = 1\ atm$

Static Temperature $T_1 = 300\ k$

$$\frac{\partial \rho}{\partial t} + \mathbf{u} \cdot \nabla \rho + \rho \nabla \cdot \mathbf{u} = 0 \qquad \frac{\partial \mathbf{u}}{\partial t} + \mathbf{u} \cdot \nabla \mathbf{u} = -\frac{\nabla p}{\rho}$$

1. Geometry

Create Design Modeler



2. Mesh

Mesh Control > Face Meshing

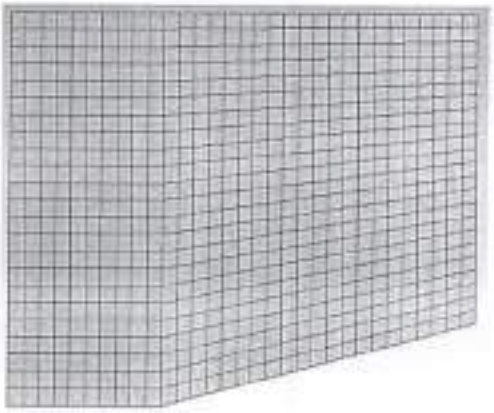
click **Geometry > Apply**

Body Sizing

Mesh Control > Sizing. Next, select the body selection filter in the menu bar:

In the Details window, select **Geometry > Apply. Element Size > Default** and change the value to **0.05** m.

Mesh > Generate Mesh



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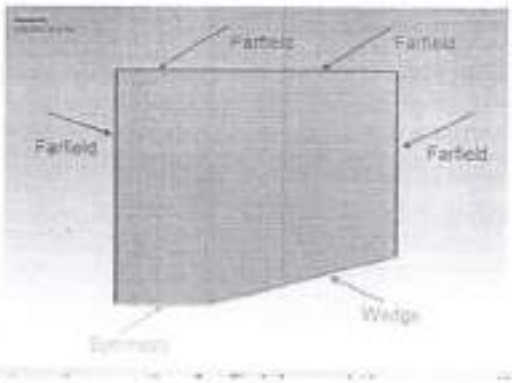

3. Setup

Launch the Solver-Select the Solver-Click OK to launch Fluent.Energy-On-inviecid.

Problem Setepg > General. Under Solver, select density based

Models and Materials

Density to Ideal Gas. the default values for Cp (1006.43), and the Molecular Weight (28.966) density. Click Change/Create to set the density.

Boundary Conditions

Select farfield. Use the drop-down menu to change the Type to pressure-far-field. Change the Gauge Pressure (Pascal) to 101325, and Mach Number to 3.Also, select the Thermal tab, and ensure that the temperature correctly defaulted to 300 K. When you are finished, press OK.

Wedge In the Boundary Conditions window, select wedge. change the Type to wall.

Symmetry In the Boundary Conditions window, select symmetry.

Operating Conditions In the Boundary Conditions window, select the Operating Conditions button. Change the Gauge Pressure to 0. Then press OK

in materials to Ideal Gas, Fluent calculates the density using the absolute pressure. However, the pressure we specify is the gauge pressure, not the absolute pressure. Fluent will use the absolute pressure to compute the density, therefore if we do not set the operating pressure to 0 our density will be incorrect for the flow field.

Reference Values In the Outline window, select Reference Values. Change the Compute From parameter to farfield.

Solution

Solution Methods to open the Solution Methods window. Under Spatial Discretization, ensure that the option under Flow Second Order Upwind is selected. Solution Controls In the Outline window, select Solution Controls to open the Solution Controls window. Ensure that the Courant Number is set to 5.0.

Solution Initialization

6.Results

Velocity Vectors

In the Outline window, under Results select Colors and Animations In the Colors and Animations window, under Graphics, select Vectors. Then press Set Up...

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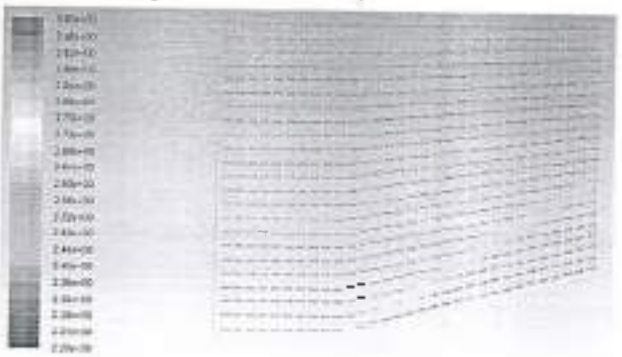
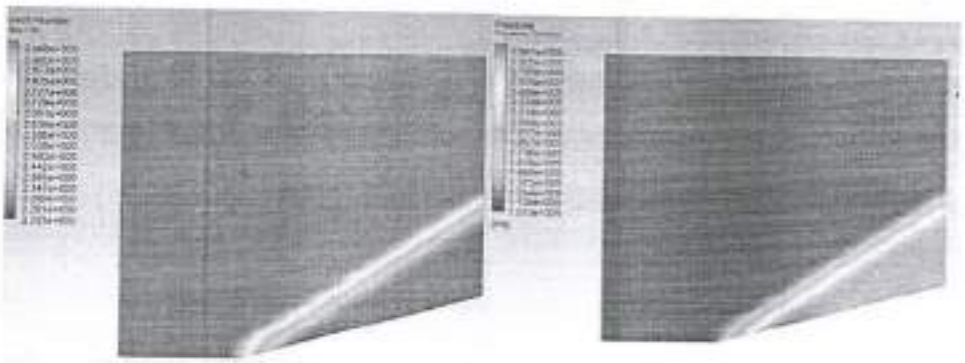
In the Vectors window that opens, change the Scale of the arrows to 0.25, and change the Color by parameter to Velocity... Mach Number.





In the Outline window under Results, select Plots. In the Plots window, select XY plot and press Set Up.... Change the Y Axis Function to Pressure... Pressure Coefficient, and select the Wedge under Surfaces.

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S.NO	ROLL NO	NAME	19/8/22	26/8/22	2/9/22	16/9/22	23/9/22	14/10/22	21/10	28/10	11/11	18/11	no of cl	no of hrs presented
1	1601-19-736 003	CHANDRA DEEPSITA JASTI	1	1	1	1	1			1	1	CASE \	7	21
2	1601-19-736-007	PRANITHA RAJ ETTAMENA	1	1		1		1			1		5	15
3	1601-19-736-011	SRUTHI SHANKER PYDIMARRY			1	1	1				1		4	12
4	1601-19-736-013	AJITH RAO BIKKINENI	1	1	1	1		1	1				6	18
5	1601-19-736-016	DEEPAK REDDY SOMALA		1	1			1					3	9
6	1601-19-736-018	DIVIJ KUMAR MALLELA	1	1	1	1	1						5	15
7	1601-19-736-023	JAGADESH CHANDRA KUMAR T		1	1	1	1	1	1		1		7	21
8	1601-19-736-024	KETAN KADALI		1		1							2	6
9	1601-19-736-030	MOHD IRFAN			1	1							2	6
10	1601-19-736 032	NIKHIL KUMAR NAILA	1		1	1							3	9
11	1601-19-736-034	PRAMOD SHYRDDI		1	1	1		1	1	1	1		7	21
12	1601-19-736 041	SAI TEJA THOTA	1	1		1	1	1	1	1	1		8	24
13	1601-19-736-042	SAIKIRAN RACHAKONDA	1	1	1	1	1		1	1	1		8	24
14	1601 19-736-044	SAIVAMSI NAGAMALLA			1	1							2	6
15	1601-19-736-045	SAKETH REDDY REDABOTH	1	1	1	1	1	1	1	1	1		9	27
16	1601-19-736-051	SUDHANSH TANNERU	1	1	1	1	1	1	1	1	1		9	27
17	1601-19-736-052	TARUN VISHNU VARDHAN	1	1	1	1	1	1	1	1	1		9	27
18	1601-19-736-053	THANDAVA SAI ROHITH ACHANTA		1	1	1		1					4	12
19	1601-19-736-054	UDAY KIRAN ANNEPARTHI		1	1	1		1	1	1	1		7	21
20	1601-19-736-056	VENKATESH LAKSHMI CATI	1	1	1	1			1	1			6	18
21	1601-19-736 059	YASHOVARDHAN MADURI				1							1	3
22	1601-19-736-306	K PRAVEEN KUMAR	1	1	1	1	1	1	1	1	1		9	27
23	1601-19-736 047	Sasi Kiran			1									0

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on

Computational Fluid Dynamics for Automobile and Aviation

Course completion certificate

This is to certify that Mr./Ms./Mrs *CHANDRA EEPSITA JASTI*, Roll No: *1601-19-736-003*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

Dr.Ch.Indira Priyadarshini
(Assistant Professor
Coordinator)

Prof.P.V.R.Ravindra Reddy,
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Prof.P.Ravinder Reddy
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This is to certify that Mr./Ms./Mrs *PRANITHA RAJ ETTAMENA*, Roll No: *1601-19-756-007*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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on

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This is to certify that Mr./Ms./Mrs *SRUTHI SHANKER PYDIMARRY*, Roll No: *1601-19-736-011*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *AJITH RAO BIKKINENI*, Roll No: *1601-19-736-013*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *DIVIJ KUMAR MALLELA*, Roll No: *1601-19-736-018*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *JAGADESH CHANDRA KUMAR T*, Roll No: *1601-19-736-025*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *PRAMOD BHYREDDI*, Roll No: *1601-19-736-095*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *SAI TEJA THOTA*, Roll No: *1601-19-736-041*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *SAIKIRAN RACHAKONDA*, Roll No: *1601-19-736-042*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *SAKETH REDDY REDABOTHU*, Roll No: *1601-19-736-045*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *SUDHANSH TANNERU*, Roll No: *1601-19-736-051*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *TARUN VISHNU VARDHAN CHIRUMELLA*, Roll No: *1601-19-736-052*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENCINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *THANDAVA SAI ROHITH ACHANTA*, Roll No: *1601-19-736-053*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *UDAY KIRAN ANNEPARTHI*, Roll No: *1601-19-736-054*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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This is to certify that Mr./Ms./Mrs *VENKATESH LAKSHMI CATTI*, Roll No: *1601-19-736-056*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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Course completion certificate

This is to certify that Mr./Ms./Mrs *K PRAVEEN KUMAR*, Roll No: *1601-19-736-306*, has successfully completed value added course on Computational Fluid Dynamics for Automobile and Aviation, organised by DEPT OF MECHANICAL ENGINEERING from 19th August 2022 to 11th Nov 2022.

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(Principal)

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Gandipet, Hyderabad-500 075, Telan

Title of the value added course:

Computational Fluid Dynamics for Automobile and Aviation

Code: CBIT/MEV02

Duration: 30 hrs

(from 19-08-2022 to 11-11-2022)

Target participants: All UG students

Academic year: 2022 – 23

Outcome of the course:

This course will be useful for placements and will be helpful in pursuing higher studies.

Title of the value added course:

MATLAB for Mechanical Engineers

Code: CBIT/MEV01

Duration: 30 hrs
(from 26-10-2022 to 19-02-2023)

Target participants: All UG students

Academic year: 2022 - 23

Chaitanya Bharathi institute of Technolgy, Gandipet, Hyderabad
Departement of Mechanical Engineering

Circular

15/09/2022

Sub : Value added courses of 2022-23 odd semester- Announcement.

To enhance the knowledge in various areas beyond curriculum Value added course recommended. In this regard the interested students may register for the same on or before 25-08-2022. The course is scheduled from 26th oct 2022 to 19th Feb 2022.

The list of courses;

1) MATLAB for Mechanical Engineers(CBIT/MEV01)

For further information contact course coordinators.

Course coordinators:

1) MATLAB for Mechanical Engineers(CBIT/MEV01) : K.Gurubrahmam ,Assistant Professor MED, 9491377882, gurubrahmam mech@cbit.ac.in

Head
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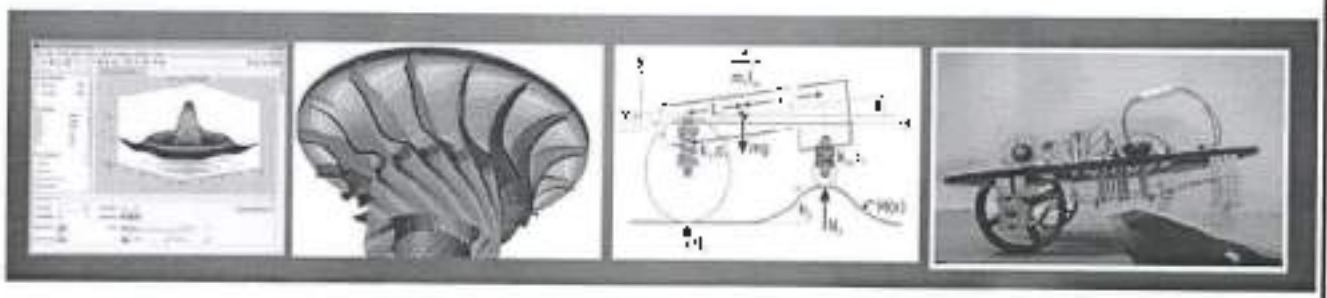
Department of Mechanical Engineering

Value Added Course

On

MATLAB FOR MECHANICAL ENGINEERS (CBIT/MEV01)



Objective of the Course:

MATLAB gives Analyze data both numerically and statistically, easily perform iterations and conditional calculations, Solve complex math problems, Plot and visualize data, Automate a task or calculation

Introduction:

MATLAB is commercial software and a trademark of The MathWorks, Inc., USA. It is an integrated programming system, including graphical interfaces and a large number of specialized toolboxes. MATLAB is getting increasingly popular in all fields of science and engineering. It provides an interactive environment with hundreds of built-in functions for technical computation, graphics, and animation. Best of all, it also provides easy extensibility with its own high-level programming language. The name MATLAB stands for MATrix LABoratory.

MATLAB's built-in functions provide excellent tools for linear algebra computations, data analysis, signal processing, optimization, numerical solution of ordinary differential equations (ODEs), quadrature, and many other types of scientific computations. Most of these functions use state-of-the-art algorithms. There are functions for 2-D and 3-D graphics, as well as for animation. Also, who cannot do without their Fortran or C codes codes, MATLAB even provides an external interface

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to run those programs from within MATLAB. The user, however, is not limited to the built-in functions; can write his own functions in the MATLAB language. Once written, these functions behave just like the built-in functions. MATLAB 's language is very easy to learn and to use. There are also several optional "toolboxes" available from the developers of MATLAB. These toolboxes are collections of functions written for special applications such as symbolic computation, image processing, statistics, control system design, and neural networks The list of toolboxes keeps growing with time. There are now more than 50 such toolboxes. The basic building block of MATLAB is the matrix. The fundamental data type is the array. Vectors, scalars, real matrices, and complex matrices are all automatically handled as special cases of the basic data type.

Matlab in fact an industry standard for data acquisition and mathematical modelling. When it comes to mathematical modelling in all Aerospace, Automobile. Control system domain it is an industry standard. Almost in all the IITs, IISc, universities, students and professors use it for research purposes.

Mechanical Engineers require MATLAB to analyse problems in basic engineering mechanics, vibrations, control system, statistics and dynamics of different circuits. MATLAB is probably the all-rounder tool for simulations, programming, graphs, measurement & automation and statistics for an engineer. Here are some areas where MATLAB and SIMULINK plays a vital role:-

Kinetics, Kinematics and complete dynamic system of Automotive suspensions. – The toolbox consists of functions that deal primarily with homogeneous transforms and their Lie algebra. It has a set of functions for interacting with serial link kinematic structures.

Thermal systems: – Thermodynamics based applications in automotive, aerospace and industrial control. Thermolib is the thermodynamic and thermo-chemical tool that seamlessly integrate into the MATLAB and Simulink environment. One of the feature is to calculate real gas behavior based on the Peng-Robinson EOS.

Finite Element Analysis: – FEA deals with the stiffness matrix. Manually assembling the matrix might be hectic and time-consuming. MATLAB makes it easier to assemble the stiffness matrix, giving you time to concentrate on other domains.

SIMULINK provides various models such as mechanical, hydraulic, thermal and isothermal liquid models, two phase fluid models, gas models, moist air model etc. One can model the entire control of mechanical system using MATLAB and SIMULINK. With MATLAB 2D, 3D and surface plots can also be created faster. Whether you are a thermal engineer performing auto cycle simulations or an automobile engineer doing vehicle dynamic simulation, MATLAB is easy and can be used to do computational project for every subject you learn. Hence, Mechanical engineers of Design and manufacturing field use MATLAB and Simulink heavily. You would be surprised to know that MATLAB also forms the based for different CAD software as well as designing software just like SOLIDWORKS. As, it is easier to learn and use MATLAB, it is widely accessible to the students in the form of free and paid versions.

Automation, core companies are looking for mechanical engineers who can integrate their technical knowledge with an automation tool. Numerous job opportunities are available for a mechanical engineer specialised in MATLAB. Also, Software companies like Google and Facebook hire Mechanical/Thermal engineers to ensure efficient and safe thermal management of their database and cluster computers in their respective companies.
Industrial Automation and Machinery engineers use Model-Based Design in MATLAB and Simulink to. **Design and test machine controls and supervisory logic**. Run automatic tests on equipment functions. Design artificial intelligence (AI) algorithms for predictive maintenance and operations optimization.

Some capabilities of MATLAB in Mechanical Engineering are:

- Structurel Analysis
- Computational Fluid Dynamics
- Thermal Analysis
- Analysis of composite structures
- Industrial Production technology
- Control systems

Industries

Aero/Aviation/Automotive industries working with MATLAB:

MATLAB is extensively used in Defence, Space technology, Aerospace and Automobile industries because of its application in modelling and finite element analysis. It is also used in Mass production industries.

Companies ranging from automotive, banking, and software implement the MATLAB software. The lists of companies in automotive sector using the MATLAB Software are:

- Volvo
- Jaguar
- Mercedes
- BMW

A company from the software sector includes:

- Adobe Photoshop

All the Banking companies which involve crunches of calculations such as Citi Bank, HDFC do implement the concepts indirectly

Payscale.com survey confirms that the basic mechanical engineer salary with MATLAB skills may vary from **5,00,000–5,80,000** per annum in India while internationally it begins from **$40,000** per annum. The typical MathWorks Software Engineer salary is **₹10,33,333**. Hence, a B-tech degree with a specific MATLAB skill would fetch a lot of job opportunities as well as higher studies opportunities.

Prerequisite:

1. C Programming, Basics of Engineering Mathematics
2. No prior knowledge of Matlab is required. Basic computer literacy is expected.

Course Objectives:

1. To Impart the Knowledge to the students with MATLAB software
2. To provide a working introduction to the Matlab technical computing environment.
3. To introduce students the use of a high-level programming language, Matlab.

Outcome of the course: After completion of course students will be able to

1. Programming knowledge in Research and Development.
2. Themes of data analysis, visualization, and programming.
3. Scientific problem solving with applications and examples from Engineering.

Selection criteria:

- Students will be selected based on their CGPA in 2:1 ratio (20 students per course)
- Students has to give interview
- Based on performance 20 students will be selected.

Modalities of the conduction of course:

- The course of 30 hours planned to conduct during college timings in Library period.
- Interested Students has to apply for the course.
- Students need to submit all assignments and Present real time case study during the course as a project report.
- Certificate will be issued after completion of the course to the students with 80% attendance.

- Topics to be covered:

1. Basics of Matlab and MATLAB Compiler
   The Matlab user interface
   Working with Matlab data types
   Creating matrices and arrays
   Operators and control statements
   Using scripts and functions
   Data import and export
   Using the graphical features

2. Programming with simple examples

CBIT/MEV01 With Effect from the Academic Year 2022-2023

MATLAB FOR MECHANICAL ENGINNERS

Instruction (Periods per week) 2 Periods
Duration of End Examination 3 Hours

Module-1	Basics of MATLAB, MATLAB windows, On-line help, Input-output, File types, General commands should remember. Add, multiply, and exponentiation numbers, use trigonometric functions; and control screen output with format.-	2H
Module-2	Creating and Working with Arrays of Numbers, Creating and Printing Simple Plots, Write and execute a script file, Write and execute a function file.-	3H
Module-3	Arrays and Matrices, Working with Anonymous Functions. Symbolic Computation, Importing and Exporting Data, Working with Files and Directories. Publishing Reports.-	2H
Module-4	Matrices and Vectors, Matrix and Array Operations, Character strings, Command-Line Functions,-	3H
Module-5	Using Built-in Functions, Saving and Loading Data, Programming in MATLAB: Scripts and Functions: Script Files, Function Files	- 3H
Module-6	Applications: Linear Algebra, Curve Fitting and Interpolation, Numerical Integration, Ordinary Differential Equations, Nonlinear Algebraic Equations -	2H
Module-7	Graphics: Basic 2-D Plots, Using subplot for Multiple Graphs, 3-D Plots, 3-D Surface Graphics	2H

List of the Exercises-13H

1) Figure 1 shows a frame in which the structural members support the 5 kN load. The load may be applied at any angle α (-· 90° to + 90°). The pins at A and B need to be designed to support the maximum force transmitted to them. Write a MATLAB program to plot the forces at A and B as a function of α and find their maximum values and corresponding angles α.

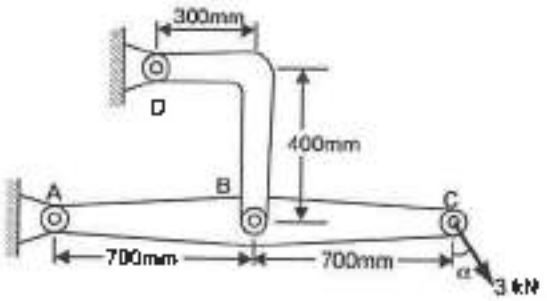

Figure. 1

2) In figure 2, the spring is unstretched when α = 0 and k is the spring constant. Write a MATLAB program to compute and plot the mass m corresponding to equilibrium as a function of α for values of α from 0° to 90°. Find the value of α corresponding to equilibrium m=2.5kg. Given R = 210 mm,d = 50 mm and k = 1.2 kN/m.

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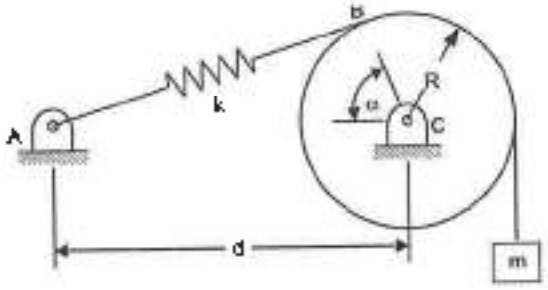

Figure. 2

3) Figure 3 shows a crank shaft mechanism where a couple M is applied to the crank AB to maintain the equilibrium of the system. The force applied to the system is F. Write a MATLAB program to plot the ratio of M/F as a function of crank angle α from 0 to 180 degrees. Given a = 50 mm and A = 150 mm. Determine the value of crank angle α for which the ratio M/F is maximum and the corresponding value of M/F.

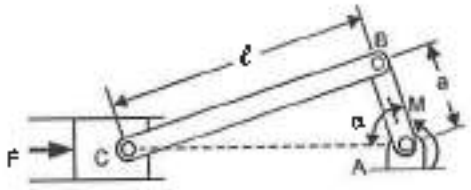

Figure 3

4) Figure 4 shows axle pulley system where the coefficient of friction between cable ABCD and the pulley varies between 0 and 0.60. Write a MATLAB program to determine, (a) the values of α for the system to remain in equilibrium (b) the reactions at A and D (c) Plot α as a function of the coefficient of friction.

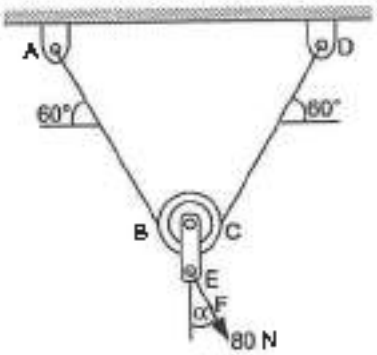

Figure 4

5) Figure 5 shows a safety bumper placed at the end of a racetrack to stop out-of-control vehicles. The force that the bumper applies to the vehicle is given by $F = Kv^3 (x + 1)^3$ where K = 32 kg-s/m5 (a constant) x = displacement of the front edge of the bumper v = velocity of the front edge of the bumper. A vehicle of mass 2000 kg hits the bumper at a speed of 100 km/h. Write a MATLAB program to determine and plot the velocity of the vehicle as a function of x for $0 \leq x < 5$m.

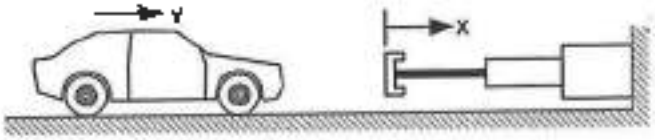

Figure 5

6) A 5 kg block is attached to a cable and to a spring as shown in Fig. 6. The constant of the spring is k = 3 kN/m and the tension in the cable is 30 N. When the cable is cut.

(a) derive an expression for the velocity of the block as a function of its displacement x, (b) determine the maximum displacement x m and the maximum speed v m, (c) plot the speed of the block as a function of x for $0 \leq x \leq x_m$.

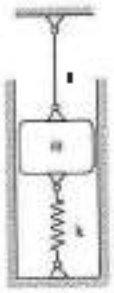

Figure 6

7) Figure 7 shows the slider crank mechanism. Write a MATLAB program that calculates and plots the position, velocity and acceleration of the piston for one full revolution of the crank. Assume that the crank is rotating at a constant speed of 550 rpm. Given radius of crank = 125 mm and radius of crank shaft – 250 mm.

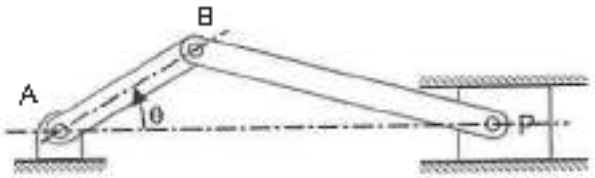

Figure 7

8) Write a MATLAB script for plotting (a) the non-dimensional response magnitude for a system with harmonically moving base shown in Fig. 8 (b) the response phase angle for system with harmonically moving base.

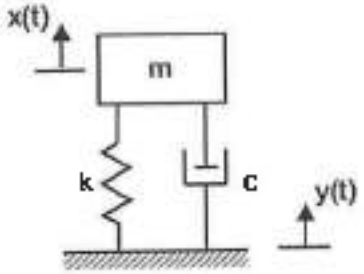

Figure 8

9) Rectangular fin of uniform cross section, with width of 18mm and thickness of 5mm and length of 100 mm is attached to the wall with surface temperature of 320 °C. The fin is made of material with thermal conductivity of 50 w/mk. The ambient air temperature is 24°C and the convection heat transfer coefficient of 15W/m k.

1- (**Plot**) the temperature variation for the following boundary condition

a- Infinitely long fin, b- Adiabatic fin tip, c- Convection from the fin tip.

2- Find the temperature at the midpoint of the fin length

3- Find the heat transfer rate, 4- Find the fin efficiency

S.NO	Email Address	R.No	Name of Student	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total classes	Attendance Percentage	[illegible]
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Akumalla Nimish Bhargav*, roll Number *160121736010*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
(Assistant Professor, Coordinator)

Prof.P.V.R.Ravindra Reddy,
(HOD of Mech. Engg, CBIT)

Prof.P.Ravinder Reddy
(Principal)

PROFESSOR & HEAD
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Prof.P.Ravinder Reddy
(Principal)

PROFESSOR & HEAD
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(HOD of Mech. Engg. CBIT)

Prof.P.Ravinder Reddy
(Principal)

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Prof.P.Ravinder Reddy
(Principal)

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This is to certify that Mr./Ms./Mrs *Pabbu.Omsri*, roll Number *160121736082*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
(Assistant Professor, Coordinator)

Prof.P.V.R.Ravindra Reddy,
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *V CHATURYA* , roll Number *160121736083*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
(Assistant Professor, Coordinator)

Prof.P.V.R.Ravindra Reddy,
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Abdulmateen Manzoor Ahmed* , roll Number *160121736085*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *B KRISHNA MOURYA* , roll Number *160121736091*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *GANGARA3U SAIRAM*, roll Number *160121736101*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *Jayesh Reddy*, roll Number *160121736107*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Mummaka Bala Sai Srinandan* , roll Number *160121736115*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Praneeth Chary Kammari*, roll Number *160121736122*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Achyuth Karthikeya* , roll Number *160121736127*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *RUBENDRA*, roll Number *60121736304*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
(Assistant Professor, Coordinator)

Prof.P.V.R.Ravindra Reddy,
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *Regulla Saidheeraj* , roll Number *60121736308*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *AKINA3ELLY SHARAD VAMSHI*, roll Number *60121736309*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *BODIGE NITHIN*, roll Number *60121736310*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

This is to certify that Mr./Ms./Mrs *HARISH* , roll Number *60121736911*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *Vadlamani Jyotindra Aditya* , roll Number *160121736314*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *Akshitha* , roll Number *160121736318*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *T siri chandhan* , roll Number *160121736319*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *Kethavath Nithin Rathod*, roll Number *160121736321*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
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This is to certify that Mr./Ms./Mrs *KUNDE SHANMUKHA* , roll Number *160121736320*, has sucessfully completed value added course on "Matlab for Mechanical Engineers", organized by Department of Mechanical Engineering from 26th Oct 2022 to 19th Feb 2023.

K.Gurubrahmam
(Assistant Professor, Coordinator)

Prof.P.V.R.Ravindra Reddy,
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Gandipet, Hyderabad-500 075. Telangana

Title of the value added course:

MATLAB for Mechanical Engineers

Code: CBIT/MEV01

Duration: 30 hrs

(from 26-10-2022 to 19-02-2023)

Target participants: All UG students

Academic year: 2022 – 23

Outcome of the course:

This course will be useful for placements and will be helpful in pursuing higher studies.