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COMMITTED TO
RESEARCH,
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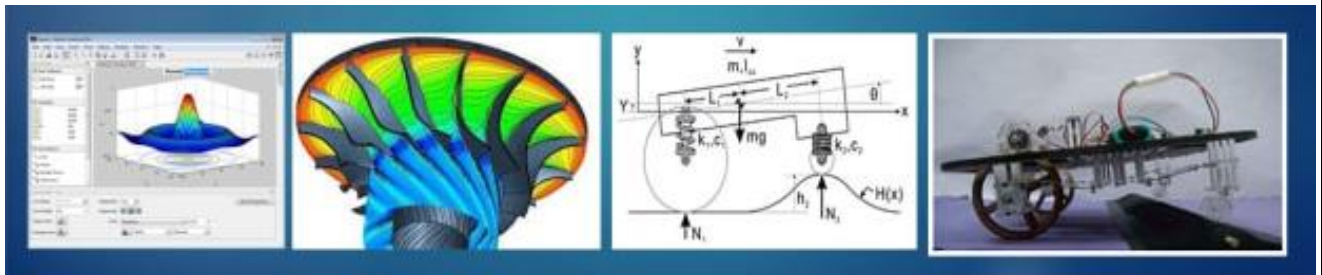
43 years

Department of Mechanical Engineering

Value Added Course

On

MATLAB FOR MECHANICAL ENGINEERS

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/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