**Birla Institute of Technology & Science, Pilani**

**Work Integrated Learning Programmes Division**

## **Computer Programming**

## **Digital Learning** **Handout**

First Semester 2022-2023

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| --- | --- |
| **Course Title** | Computer Programming |
| **Course No(s)** | ET\*\*\*\*164 |
| **Credit Units** |  |
| **Credit Model** |  |
| **Instructor-In-Charge** |  |
| **Version Number** |  |
| **Date** |  |

**Course Objectives:**

* This course will be able to create a foundation for computational problems in science and engineering
* This course will equip the students to deal with the usage of object-oriented programming tools in the engineering field
* This course will apply Python and MATLAB functionality in solving problems from Electrical, Mechanical, Manufacturing, Civil, and Aerospace Engineering to be discussed in contact sessions

**Text Book(s):**

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| --- | --- |
| **T1** | Stephen J. Chapman, Matlab Programming for Engineers, 4th Ed. Cengage Learning. |
| **T2** | Rao V. Dukkipati, MATLAB An Introduction with Applications, New Age International Publishers |
| **T3** | John Zelle, Python Programming: An Introduction to Computer Science, 2nd Ed., Franklin, Beedle & Associates Inc. Publishers. |

**Reference Book(s) & other resources:**

|  |  |
| --- | --- |
| **R1** | MATLAB The Language of Technical Computing, The Mathworks, Version 6 |
| **R2** | Need to recreate the following videos using Python.  <https://www.youtube.com/watch?v=T_ekAD7U-wU>,  https://www.youtube.com/watch?v=-JQPGKmHmPY |
| **R3** | David Beazley & Brain K Jones, Python Cookbook, 3rd Ed., O’Reilly Publications |

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| **LEARNING OUTCOMES** | |
| **LO1** | Students will be able to understand the programming applications in numeric computation and algorithm development. |
| **LO2** | Students will be able to write Python codes for the application in Control Systems, Statistics-ANOVA, Finite Element Method, and signal processing. |
| **LO3** | Students will be able to write Python scripts to understand the response with respect to the given input. |

**Experiential Learning Components:**

1. **Lab work:** Python
2. Project work: None.
3. Case study: None
4. Work-integrated Learning Exercise: None.
5. Design work/Field work: None.

**Content Structure:**

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| --- | --- | --- | --- | --- |
| **Contact Hour** | **List of Topic Title** | **Sub-Topics** | **Reference** | **Prerequisite** |
| 1-2 | Introduction to Programming, Python and MATLAB | * Compare a sample code in Python with MATLAB. * Trajectory of a particle in projectile motion (solving quadratic equations) * Ideal gas law problem to find the volume | R1- Ch.1,  T3 – Ch. 1 | Need to be created. |
| 3-4 | Understanding Arrays in Python, Representation and Operation on Arrays. | * Introduction to Python – NumPy library * Calling MATLAB engine using Python. * Maximum and Minimum values in Matrix * Potential Energy-Spring Problem | T1- Ch.2  T3- Ch. 1 | Need to be created. |
| 5-6 | Problem Solving Process | * Exercises in designing algorithms, drawing flowcharts using sequence, selection, and iterative constructs for engineering problems such as optimization. * Writing small programs involving I/O and executing it. | T1- Ch.3,  R1- Ch.5  T3 – Ch. 5 | Need to be created. |
| 7-8 | Problem Solving Process | * Exercises in writing conditions using relational, logical operations, writing programs involving if statement, if-else, if- else if and switch case statements in Python. | T1- Ch.3 | Need to be created. |
| 9-10 | Problem Solving: Iterative Constructs | * Write programs involving for-loop, while-loop and nested loops. * Exercises in vectorising programs involving loops and decisions. | T1- Ch.4  T2- Ch.3  T3 – Ch. 8 | Need to be created. |
| 11-12 | Plotting | * Introduction to Python-matplotlib library. * Plotting functions using Python-matplotlib library. * PLOT functions of Root Locus technique in Process control | T1- Ch.6  Lecture Notes. | Need to be created. |
| 13-14 | Plotting | * Introduction to Python-ScyPy library. * Use of FFT in Signal Processing * Convex hull and Contour Plots | T1- Ch.5  Lecture Notes. | Need to be created. |
| 15-16 |
| 17-18 | Modularity, Reuse: User-defined Functions | * Introduction to User-Defined Functions in Python. * Numerical Integration * Methods: Direct Techniques | T1- Ch.5  T2- Ch.6  R3 – Ch. 7 | Need to be created. |
| 19-20 | Modularity, Reuse: User defined Functions | * Numerical Integration using Gauss Elimination for Heat Transfer Problem | T1- Ch.5  T2- Ch.6  Lecture Notes. | Need to be created. |
| 21-22 | Modularity, Reuse: User defined Functions | * Exercises in Electrical Problems signifying usage of MATLAB using Python. | R1- Ch. 9  Lecture Notes. | Need to be created. |
| 23-24 | Modularity | * Exercises in writing programs of engineering mechanics | T1- Ch.7  T2- Ch.8  Lecture Notes. | Need to be created. |
| 25-26 | Modularity | * Exercises in statistics-CGPA calculations * Histograms * ANOVA | T1- Ch.7  Lecture Notes. | Need to be created. |
| 27-28 | Modularity | * Exercises in signal processing techniques * Explanation and ODE solver | T1- Ch.14  Lecture Notes. | Need to be created. |
| 29-30 | Modularity | * Examples from Mechanical engineering problems like COP calculations * Refrigeration and Air conditioning | T1- Ch.14  Lecture Notes. | Need to be created. |
| 31-32 | File Handling | * Examples from Chemical engineering (fluid mechanics and heat exchanger design) | T1- Ch.14  Lecture Notes. | Need to be created. |

**Evaluation Scheme:**

**Legend:** EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

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| --- | --- | --- | --- | --- | --- |
| Evaluation Component | Name  (Quiz, Lab, Project, Mid-term exam, End semester exam, etc.) | Type (Open book, Closed book, Online, etc.) | Weight | Duration | Day, Date, Session, Time |
|  | Lab | Online | 30% |  | **As per lab handout** |
| EC - 2 | Mid-Semester Test | Open Book | 30% | 2 hours | TBA |
| EC - 3 | Comprehensive Exam | Open Book | 40% | 2 hours | TBA |

Syllabus for Mid-Semester Test (Open Book): Topics in Contact Hours: 1 to 16

Syllabus for Comprehensive Exam (Open Book): All topics

Important links and information:

Elearn portal: https://elearn.bits-pilani.ac.in

Students are expected to visit the Elearn portal on a regular basis and stay up to date with the latest announcements and deadlines.

Contact sessions: Students should attend the online lectures as per the schedule provided on the Elearn portal.

Evaluation Guidelines:

1. EC-1 consists of either two Assignments or three Quizzes. Students will attempt them through the course pages on the Elearn portal. Announcements will be made on the portal, in a timely manner.
2. For Closed Book tests: No books or reference material of any kind will be permitted.
3. For Open Book exams: Use of books and any printed / written reference material (filed or bound) is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam which will be made available on the Elearn portal. The Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the online lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.

**Computer Programming: Simulation Lab**

**Course Handout**

**Contents:**

1. Scope of Lab

Objective of Lab

1. List of Simulation Experiments

Software Tool Used: Python

1. Learning Outcomes of Lab
2. Instruction Schedule
3. Evaluation Scheme

|  |  |
| --- | --- |
| **Faculty Name, Email Id** | **TBA** |

**Scope of the lab:**

* To solve engineering and technical problems used in manufacturing, processes which include problems in mechanical, chemical, electrical Instrumentation and control domain using Python tool. MATLAB engine will be used for comparing some of the problems using Python.

**Objectives of Lab:**

* To solve optimization Problems –Linear Programming and Simplex Method (Constrained and Unconstrained)
* Solve Heat Transfer Problem using Gauss Siedel Iteration
* Understand electrical circuits and solve them in Python.
* Solve Root locus and Control Problems using Python.
* Understanding Chemical reaction problems and solve using the ODE tool in Python.
* Usage of Polyval, Polyfit in interdisciplinary problems using Python - NumPy library.
* Solve Statistical problems in excel using Python – SciPy library.
* Solve Otto cycle efficiency problems using Python.
* Understand 2D and 3D plotting for various functions using Python - matplotlib library.

**Learning Outcome of the lab**

* To implement the use of programming tools in a plant.
* To strengthen basic concepts learnt in Statistics, mathematics and core engineering

**List of simulation experiments**

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| --- | --- | --- |
| Tut. No. | Tut. Name | Solving Time |
| 1. | To understand Optimization Problems and solve linear programming (constraint & unconstrained) using Simplex Method and Solve by Python – SciPy library. | 2 hours |
| 2. | To Solve efficiency problems using Python. | 2 hours |
| 3. | Solving Control Problems using Python. | 2 hours |
| 4. | Create a spreadsheet that has on each line an integer student identification number followed by three quiz grades for that student. Read the spreadsheet into a matrix, print the average quiz score for each student in Python and export it to excel | 2 hours |

**NOTE: Any changes in lab schedule, evaluation component or other changes related to EC-1 will be informed by theory or lab instructor.**

**Instructor-in-charge**

(ETTM ZC164)