

LEAD CITY UNIVERSITY, IBADAN FACULTY OF ENGINEERING AND TECHNOLOGY DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING SEMESTER/SESSION: SECOND SEMESTER, 2024/2025

Course Particulars

Course Code: EEE 514 Coarse Title: Use of Engineering Software Packages Course Units: 2 Course Status: Core

Lecturer's Details

Name: AKINDE, Olusola Kunle Qualifications: BTech (Computer Engineering), MSc (Microprocessor and Control Engineering), PhD. Registered Engr. (COREN) Phone: 08107232879 E-mail: ajolawale15@gmail.com

Areas of Specialization

Systems analysis and design, modeling, simulation, optimization and control. Sensors and transducers for instrumentation. Expert System.

Course Synopsis

Introduction to modeling and simulation software packages. Programming and simulation with software packages such as KiCAD, MATLAB, COMSOL Multiphysics, Python, AUTOCAD for engineering applications.

COURSE OBJECTIVES

The course objectives are to:

- facilitate the understanding of the concepts of modeling and Simulation
- facilitate the understanding of the concepts of computer Programming
- discuss the process of modeling and simulation using engineering software package(s)
- study in details the programming procedure to solve engineering problems
- develop students' ability to use software packages such as MATLAB for hands-on modeling and simulation of electrical and electronic circuits

Course Learning Outcomes (CLOs)

At the end of this course, students would be able to:

- 1. Understand and explain the fundamental of engineering software packages and programming
- 2. Identify tools used in Engineering Packages

- 3. Understand different programming control structure
- 4. Understand and explain the structure of engineering software packages
- 5. Model and simulate electrical circuit system using engineering software packages
- 6. Program micro-controller based/electrical circuit system using engineering software packages
- 7. Develop engineering simulation software application.

Lecture Delivery Method

- Lecture with interactive sessions
- Weekly Laboratory Session

LECTURE PLAN

Course Modules

Module 1: Course overview, concepts, principles, fundamental of modeling

Module 2: Concept of Simulation

Module 3: Programming and Simulation of model systems using software packages

Module 4: Modeling and Simulation of physical and microcontroller based Engineering Systems using MATLAB

Course Outline

Module 1: Course overview, concepts, principles, fundamental of modeling Number of Lecture Hours: 8

| Week | Lecture Topic | Contents | Learning Objectives |
|------|-------------------------------------|--|--|
| 1 | Introduction and Course Overview | Course outlines, delivery methods, assessments, course materials and recommended text books | Discuss the general overview of the course, rules and regulations for successful achievement in the course will be emphasized. |
| 2 | Fundamentals of Modeling | Overview of system; System attributes; Classification of systems; System analysis and synthesis; | To facilitate the understanding of the fundamental principles of system, different system classifications and how it relate to modeling. |
| 3 | Systems Modeling | Define modeling; Need of System Modeling; Explain Modeling Methods; Classification of Models; Characteristics of Models | To facilitate the understanding of system modeling and its characteristics. |
| 4 | Modeling of Physical Systems | Define mathematical model; State and State variables; Modeling of Mechanical Systems; Modeling of Electrical Systems; | Understand modeling in various fields. |

Module 2: Concept of Simulation Number of Lecture Hours: 6

| Week | Lecture Topic | Contents | Learning Objectives |
|------|-----------------|--|---------------------|
| 5-6 | Simulation and | Define simulation; Types of | Understand the |
| | Errors during | simulations; Advantages of Simulation; | concepts of |
| | Simulation with | Application of Simulation; | simulation and |
| | Numerical | Comparison of Different Numerical | comparison among |
| | Methods | Methods; | different numerical |
| | | Errors in Numerical Methods: | methods and error |
| | | Truncation Error; Round Off Error; | generated |
| | | Step Size Error; Discretization Error | |
| 7 | Simulation | Introduction to KiCAD, MATLAB, | Understand various |
| | Software | Protues and Python. | Simulation Software |
| | Packages | | Packages |
| 8 | Mid-semester | Continuous assessment | Assess students' |
| | Test | | knowledge |
| | | | development |

Module 3: Programming and Simulation of model systems using software packages Number of Lecture Hours: 8

| Week | Lecture Topic | Contents | Learning Objectives |
|--------|---|---|--|
| 9 9 | Electronic Modeling and Simulation | Introduction to different modeling and simulation Software; Introduction to MATLAB; MATLAB Environment; Data Types in MATLAB; Matrix Computations in MATLAB; Data Type Conversion | Explain fundamental of using engineering software Modeling and Simulation. |
| 10 | Programming and Simulation | Program Flow Structures: Loop; Conditional; Trial. MATLAB Functions: Structures of MATLAB Functions; Variable Numbers of Arguments; Debugging | Understand how to develop an error free MATLAB program. |
| 11 | MATLAB Applications in Scientific Computations | Linear Algebra Problems: Generating Special Matrices; Matrix Analysis and Computation; Inverse and Pseudo Inverse of Matrices; Transform and Decomposition; Eigenvalues and Eigenvectors; Solution of Matrix Equations; Nonlinear Function Evaluations; Differentiation in MATLAB Numerical Integration in MATALB. | Learning basic MATLAB syntax and applying knowledge of programming in solving some simulation computational basics. |

| 12 | Modeling | and | Description of the Simulink | To facilitate the |
|----|------------|------|---------------------------------|-----------------------------|
| | Simulation | with | Block Library: Signal Sources; | understanding of Simulink |
| | Simulink | | Continuous Blocks; Discrete- | and its application in real |
| | | | time Blocks; Lookup Table | life to model simulation. |
| | | | Blocks; User-defined Functions; | |
| | | | Math Blocks; Logic and Bit | |
| | | | Operation Blocks; | |
| | | | Simulink Modeling; Model | |
| | | | Manipulation and Simulation | |
| | | | Analysis; Practical Examples of | |
| | | | Simulink Modeling. | |

Module 4: Modeling and Simulation of physical and microcontroller based Engineering Systems using MATLAB

| Week | Lecture Topic | Contents | Learning Objectives |
|------|------------------|---------------------------------|------------------------|
| 13 | Physical System | Introduction to Simscape; | To facilitate the |
| | Modeling and | Overview of Simscape | learning of model and |
| | simulation with | Foundation Library; Description | simulation of physical |
| | Simscape | of SimPowerSystems; Modeling | engineering system. |
| | | and Simulation of Electronic | |
| | | Systems. | |
| 14 | Introduction to | Programming of microcontroller- | Design, construct and |
| | microcontroller- | based systems with Arduino | simulate |
| | based circuit | starter kit. | microcontroller-based |
| | modeling and | | system design using |
| | simulation | | MATALB. |

Number of Lecture Hours: 6

Grading/Assessment

| Attendance | - | 10 marks |
|-----------------------|---|----------|
| Continuous Assessment | - | 20 marks |
| Mid-semester Test | - | 10 marks |
| Examination | - | 60 marks |

References

Chaturvedi, D. K. (2010). Modeling and Simulation of System Using MATLAB and Simulink (1st

ed.) [Electronic]. Taylor and Francis Group, LLC. https://www.taylorandfrancis.com

Xue, D., & Chen, Y. (2014). System Simulation Techniques with MATLAB® and Simulink® (1st

ed.) [Electronic]. John Wiley & Sons, Ltd. https://www.wiley.com

EEE 514 Tutorial Questions

Question 1

15marks

- i) Define system.
- Discuss the following system attributes: a) System boundary b)System components ii) and their interactions c) Environment
- According to the Time Frame discuss system classification iii)
- Define the following concept as relate to system: a) Analysis b) Synthesis iv)

Question 2

- i) Define modeling.
- ii) Discuss reasons why real systems are not been used to performed experiments.?
- iii) Discuss and compare with appropriate diagram the three methods applicable to Complex Systems?

Question 3

- i) Discuss all classification of Models you know,?
- ii) Define state and state variables

Question 4

Consider a tank of volume V which is full of a solution of a material A at concentration C. A solution of the same material at concentration C_0 is flowing into the tank at low rate F_0 and a solution is flowing out the top of the tank at low rate F_1 . Determine the dynamic response to a step change in the inlet concentration C_0 .

Hint1: Well mixed solution, density of solution is constant and level is constant in the tank. Hint2: $F_0 = 0.085 \ m^3/\text{min}$, V = 2.1 m^3 ; $C_{init} = 0.925 \ \text{kg}/m^3 \ \text{t} < = 0$; $C_0 = 1.85 \ \text{kg}/m^3 \ \text{t} > 0$

Ouestion 5

Develop a computer program in MATLAB to simulate the hydraulic system in question 4.

Question 6

- a) The figure below shows a simple mechanical translational system with a mass, a spring, and a dashpot. A force F is applied to the system. Derive a mathematical model for the system.
- b) Develop a simulation program in MATLAB for the given system above.



Question 7 Figure beld

iductor, and a resistor.

The inductor and the capacitor are connected in parallel. A voltage V_a is applied to the circuit. Derive a mathematical model for the system.



15marks

15marks

15marks

15marks

15marks

| Question 8 | | 15marks |
|--|---|-----------------|
| i) Define Simulation? | | |
| ii) Discuss six (6) Advantages of Sin | mulation? | |
| iii) State five (5) areas of application | of Simulation? | |
| Question 9 | | 15marks |
| a) State the characteristics of Nume | rical Methods in Simulation? | |
| b) In tabular form compare differen | t Numerical Methods? | |
| c) Explain Truncation error and Rou | und off error | |
| Question 10 | | 15marks |
| a) Explain the following concepts in | n MATLAB (i) Constants (ii) Variables. | |
| b) Explain the following constants i | n MATLAB (i) eps (ii) Inf (iii) NaN. | |
| c) .Explain the two kinds of Loop S | tructures in MATLAB with their syntax. | |
| Question 11 | | 15marks |
| a) Write the general syntax of If and | d Switch case statement in MATLAB? | |
| b) Explain Trial Structure in MATL | AB? | |
| c) Explain structures of MATLAB | Functions | |
| Question 12 | | 15marks |
| d) Explain the main blocks in the Si | gnal Sources group in Simulink? | |
| e) Explain the blocks in the Continu | ous group in Simulink? | |
| Question 13 | | 15marks |
| a) Discuss how to Output and Printi | ing of Simulink Models? | |
| b) A function (x) is given as: x^4 + | $-3x^3 + 4x^2 + 2x + 6$. Plot (x) for a per- | riod {-1,1} and |
| find roots of $f(x)$ using MATLAI | 3 code. | |
| Question 14 | | 15marks |
| a) List Commonly used block group | o in Simulink? | |
| b) Discuss Simscape modeling prog | ram in Simulink? | |
| Question 15 | | 15marks |
| Discuss in details Overview of S | imscape Foundation Library? | |
| Question 16 | | 15marks |
| Perform Simple Traffic Simulati | on using Matlab. | |