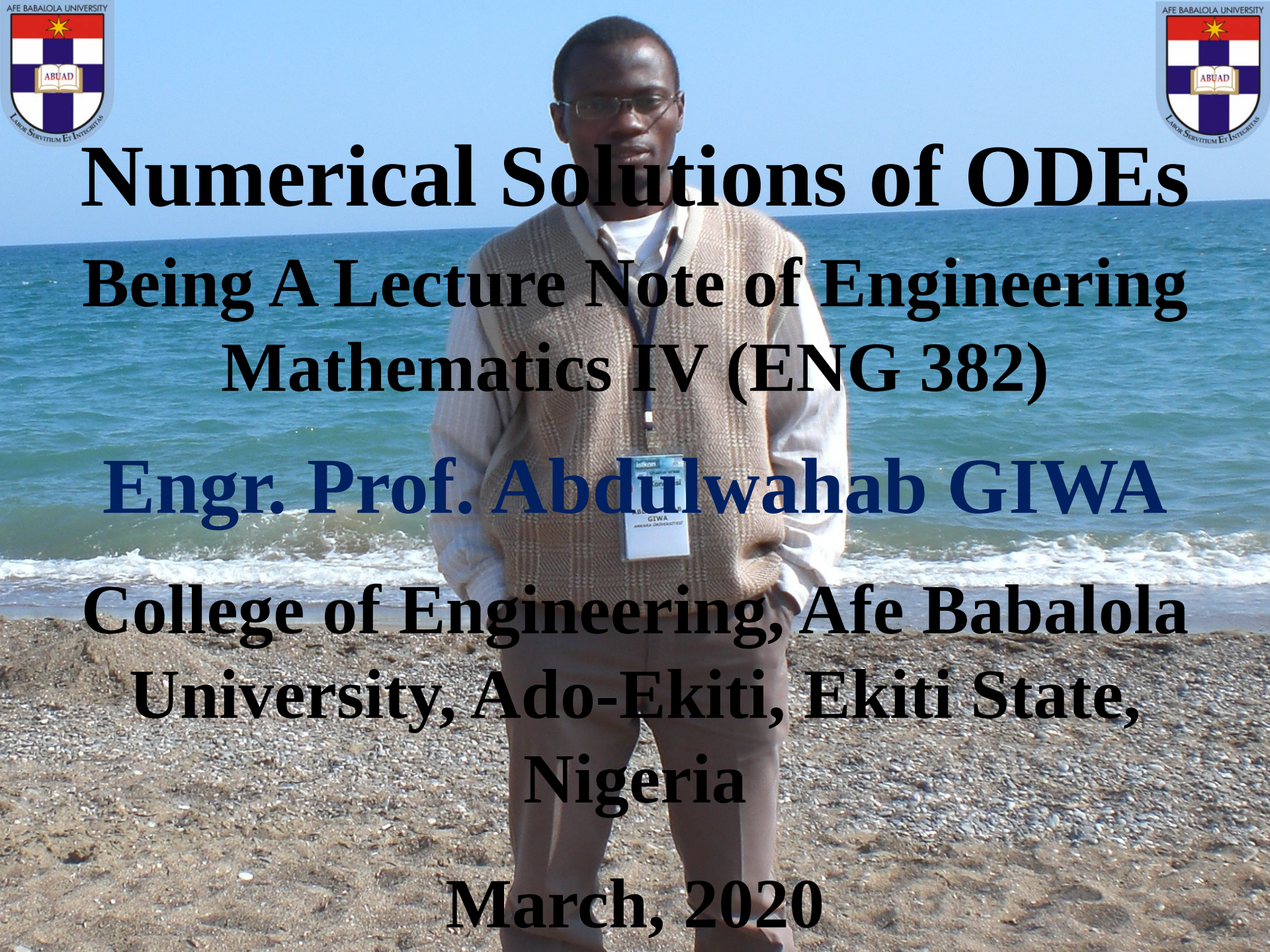

Numerical Solutions of ODEs

Being A Lecture Note of Engineering Mathematics IV (ENG 382)

Engr. Prof. Abdulwahab GIWA

College of Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria

March, 2020

Using MATLAB Built-In ODE Commands

- ODEs can be solved with the aid of MATLAB using built-in commands like *ode45*, *ode23*, *ode113*, *ode15s*, *ode23s*, *ode23t* and *ode23tb*.
- To use any of these commands to solve ODEs, two *mfiles* are required: (1) a function file and (2) a simulation file.

Example

The mathematical model set of a two-tank system is given, in form of two differential equations, to be as in Equations (1) and (2).

$$\frac{dh_1}{dt} = -0.02h_1 + 0.02h_2 \quad (1)$$

$$\frac{dh_2}{dt} = 0.02h_1 - 0.02h_2 \quad (2)$$

$$h_1(0) = 0 \quad (3)$$

$$h_2(0) = 140 \quad (4)$$

Using the initial conditions given in Equations (3) and (4), solve the model set of the system for $0 \le t \le 170\,\text{min}$.

Function file

```
function dydt = ebosafun(t,y)

dydt(1) = -0.02*y(1) + 0.02*y(2);
dydt(2) = 0.02*y(1) - 0.02*y(2);
dydt = dydt';
```

Solution

Simulation File

```
commandwindow
clearvars
clc
close all

[t,h] = ode45('ebosafun',[0 170], [0 140]);

figure(1)
subplot(2,1,1)
plot(t,h(:,1))
xlabel('Time (min)')
ylabel('Tank 1 liquid level (m)')
grid on
grid minor
axis tight
```

Simulation File (Contd.)

```
subplot(2,1,2)
plot(t,h(:,2))
xlabel('Time (min)')
ylabel('Tank 2 liquid level (m)')
grid on
grid minor
axis tight

figure(2)
plot(t,h)
xlabel('Time (min)')
ylabel('Liquid level (m)')
legend('Tank 1', 'Tank 2')
grid on
grid minor
axis tight
```


I CARE ABOUT YOU.
PLEASE, STAY SAFE!!!
THANKS.