School of Electronics and Communication Engineering
Academic Year 2020 - 2021

Mini Project Report - Trimester VI

Title of the Project: GUI for SSBSC Signal Generation and Detection
Course Name: Analog Communication
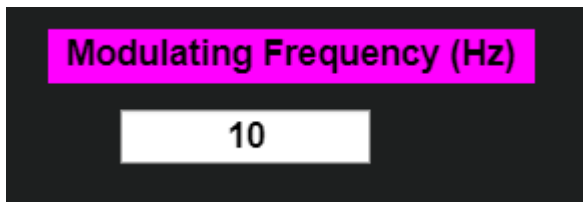**Name of Students: 1) Satyam Morankar PC38**
2) Nishant Jain PC36

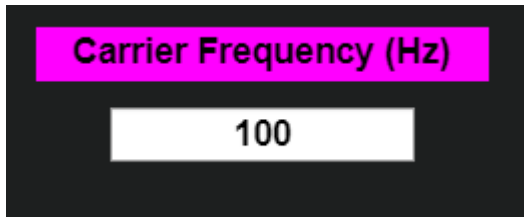| Sr. No.	PRN No.	Name of Student	Contact No.	Email ID
1	1032191508	Nishant Jain	9057788298	Nishantjain46159@gmail.com
2	1032191512	Satyam Morankar	8788417576	morankarsatyam@gmail.com

Introduction:

In this project we have designed GUI based model for SSB-SC signal generation and detection, using MATLAB App designer and Simulink. This app takes certain inputs parameters like carrier frequency, message frequency etc. and shows the signal waveform which user wants to observe. For observing the required signal user will have six options with signal names and required one can be selected to see the waveform. The GUI for SSB-SC is user friendly and easy to use and it also ease the way in which one can observe simulations. This GUI based modal can be used for educational purpose where students will have direct access to app, and they can simulate and observe different signal waveform for SSB-SC signal.
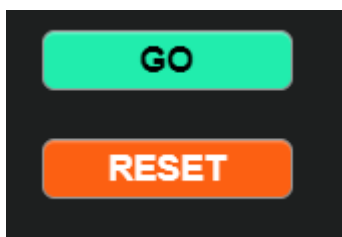
Block Schematic and Explanation:
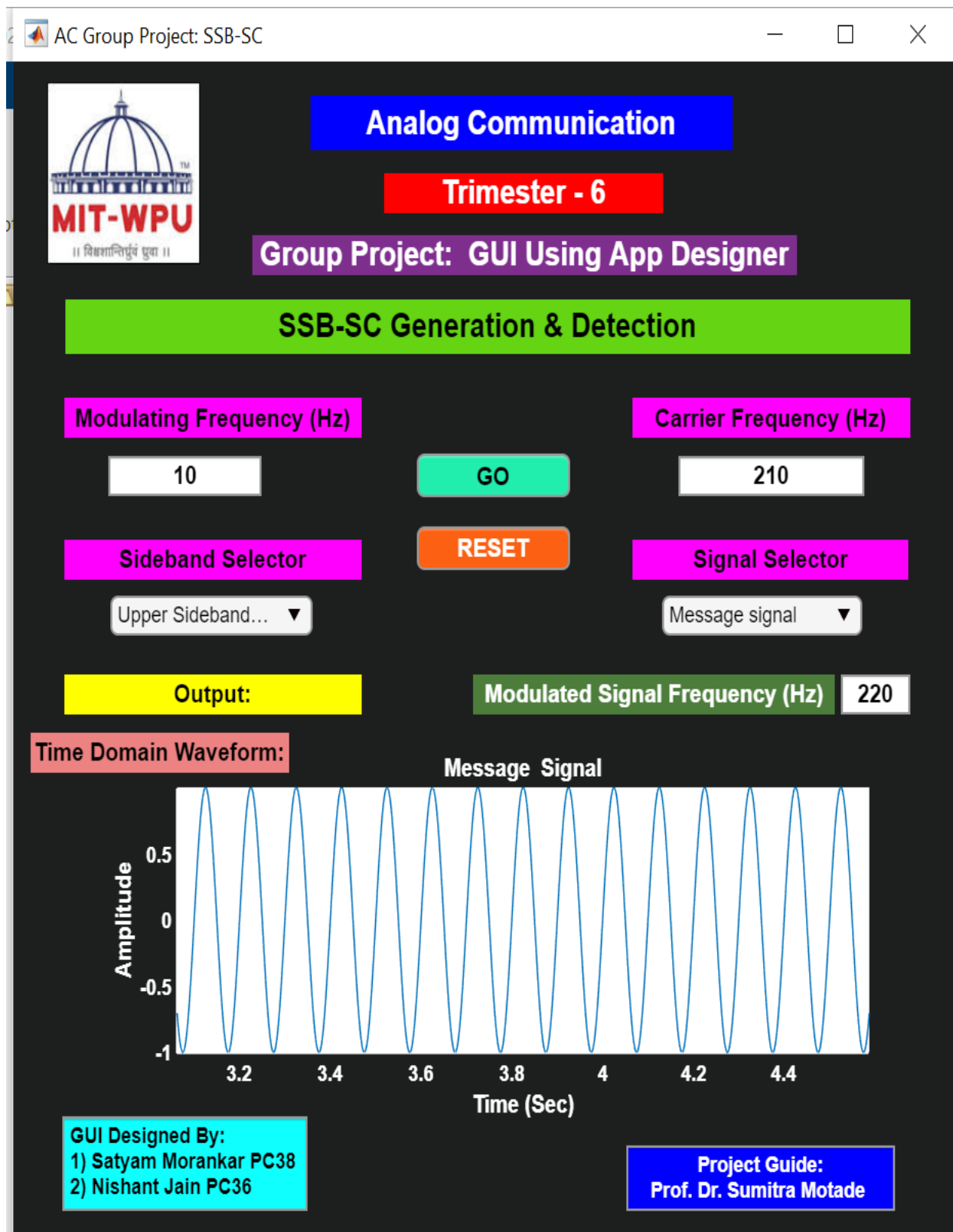
Modulating frequency box take the input for modulating frequency (in Hertz). This box takes the value upto 100 for modulating frequency, it will not accept the value if it is greater than 100.
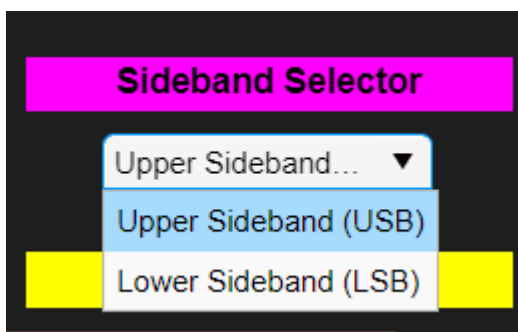
Carrier frequency box takes the input for carrier frequency(in Hertz).

Go button will run the simulation and will give the desired output for appropriated input values.

Reset button will reset the input parameters to default state or values.

Using the **sideband selector** one can select require modulated output waveform, in which upper sideband and lower sideband can be selected.
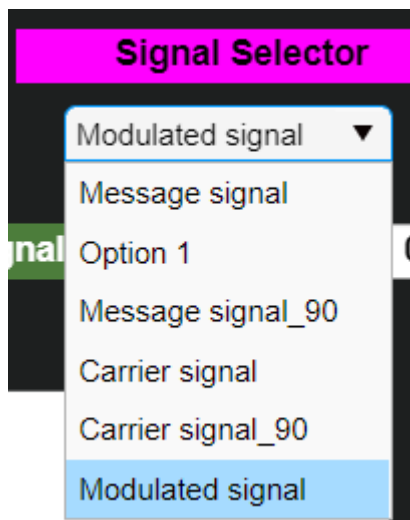
Using this **dropdown menue** one can select the required output waveform for observation.
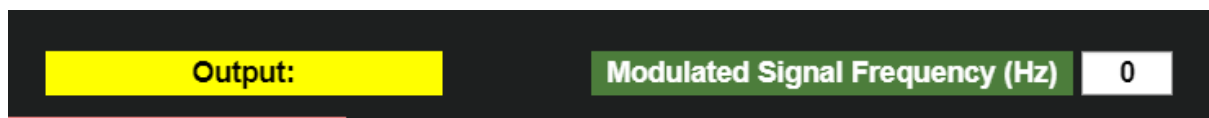
This **Output block** shows the frequency of output modulated waveform.
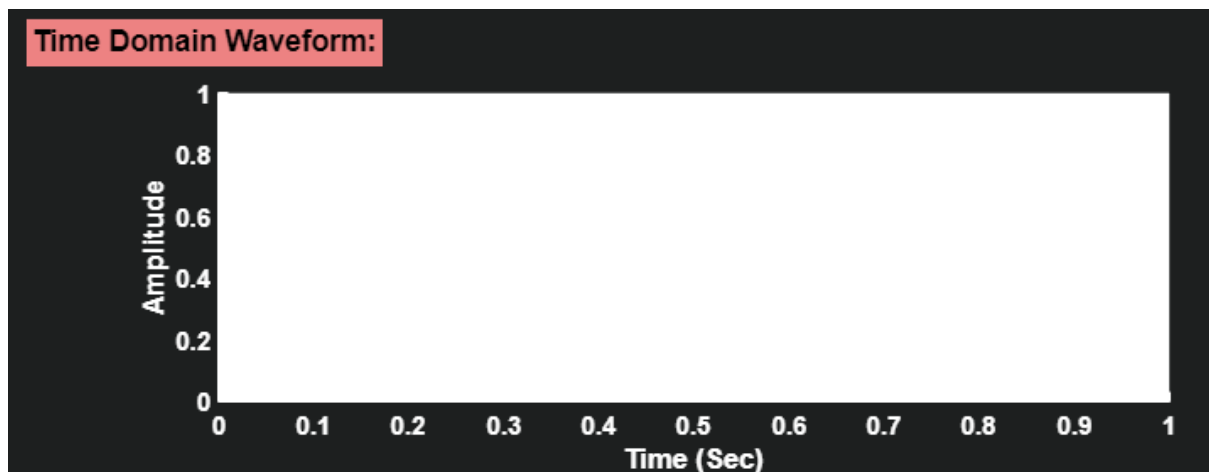
This **window shows** the output waveform of the selected signal, for the input values of carrier frequency and message frequency.

Specifications:

App Designer

App Designer is an interactive development environment for designing an app layout and programming its behaviour. It provides a fully integrated version of the MATLAB® Editor and a large set of interactive UI components. It also offers a grid layout manager to organize your user interface, and automatic reflow options to make your app detect and respond to changes in screen size. It lets you distribute apps by packaging them into installer files directly from the App Designer toolstrip, or by creating a standalone desktop or web app (requires MATLAB Compiler™).

Button

Buttons are UI components that respond when the user presses and releases them. By changing property values, you can modify the appearance and behaviour of a button. Use dot notation to refer to a specific object and property.

```
fig = uifigure;

b = uibutton(fig);

b.Text = 'Plot';
```

UI Dropdown

UI Dropdown(___,Name,Value) specifies object properties using one or more Name, Value pair arguments. Use this option with any of the input argument combinations in the previous syntaxes. Use the Name,Value pair, Editable,'on' to specify a drop-down component that allows the app user to type text into the drop-down component or select a predefined option.
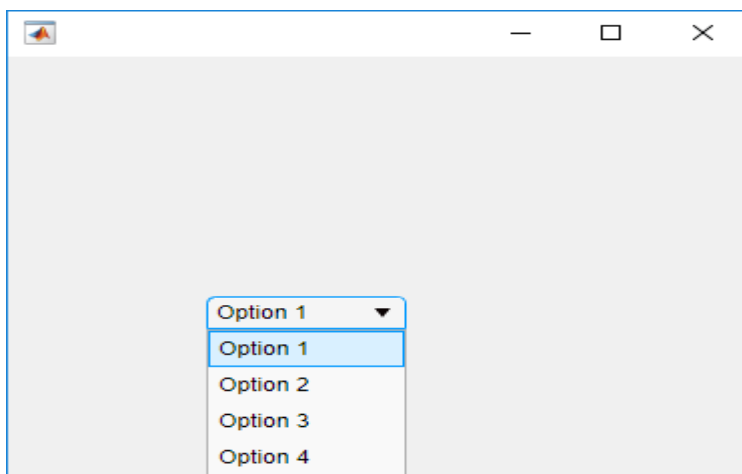
Clicking anywhere in the drop-down component causes it to open.

UI Label

 UI Label (___,Name, Value) specifies label properties using one or more Name, Value pair arguments. Use this option with any of the input argument combinations in the previous syntaxes.

UI Edit Field

UI Edit Field creates a text edit field in a new figure window and returns the Edit Field object. MATLAB® calls the UI figure function to create the figure.
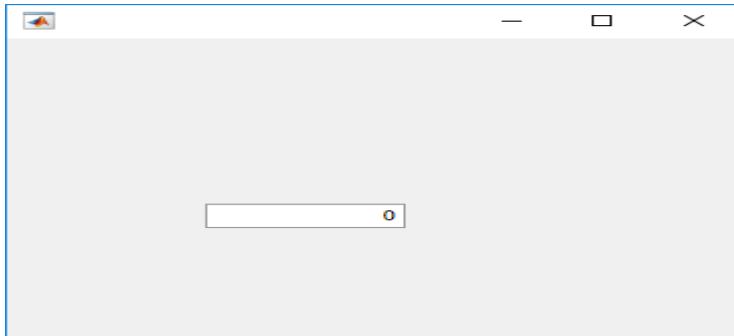
numeric edit field by specifying the style as numeric.

UI Axes

UI Axes creates a UI axes in a new figure window and returns the UIAxes object. MATLAB® calls the uifigure function to create the figure.

UIAxes objects are useful for creating Cartesian plots in apps. They are very similar to the Cartesian Axes objects returned by the axes function. Thus, you can pass a UIAxes object to most functions that accept an Axes object.
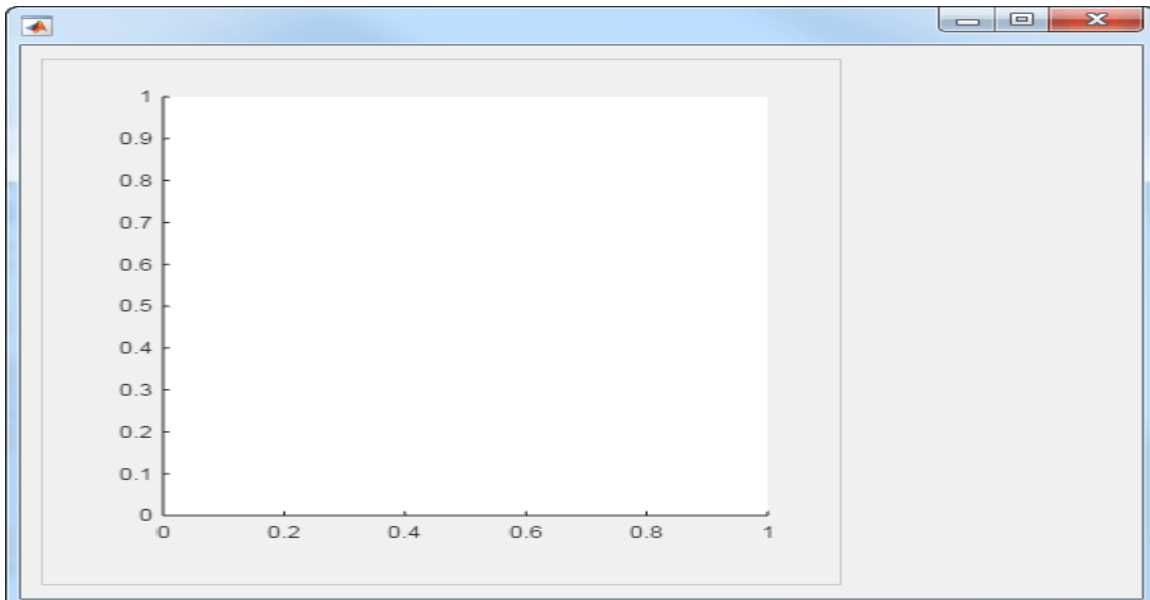
UI axes to a panel within a figure window. Specify the panel and axes positions in pixels.

Simulink Design for SSB-SC signal generation and detection
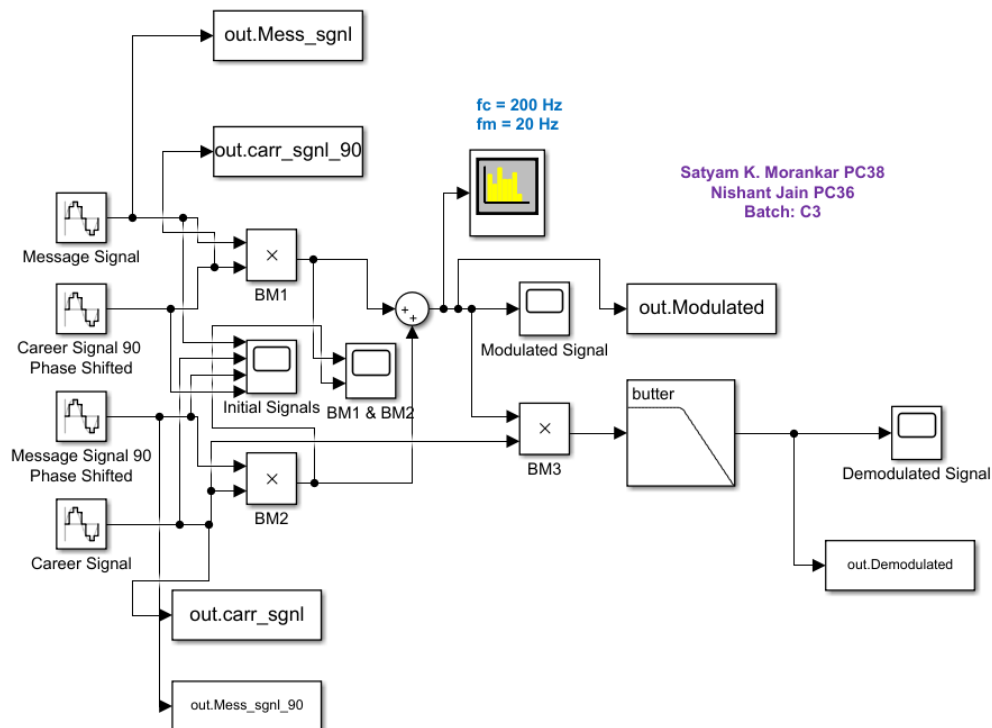
Sim out block - It Write input to specified timeseries, array, or structure in a workspace. For menu-based simulation, data is written in the MATLAB base workspace. The data for plotting is provided by Simulink using in array. When performing simulations with the sim command, we use the command line to perform operations on your simulation. Performing simulations with the Run button implies that you can interact with the simulation using the Simulink® UI to perform any other additional operations.

Screen shots:

1. Actual Implementation (Front View)
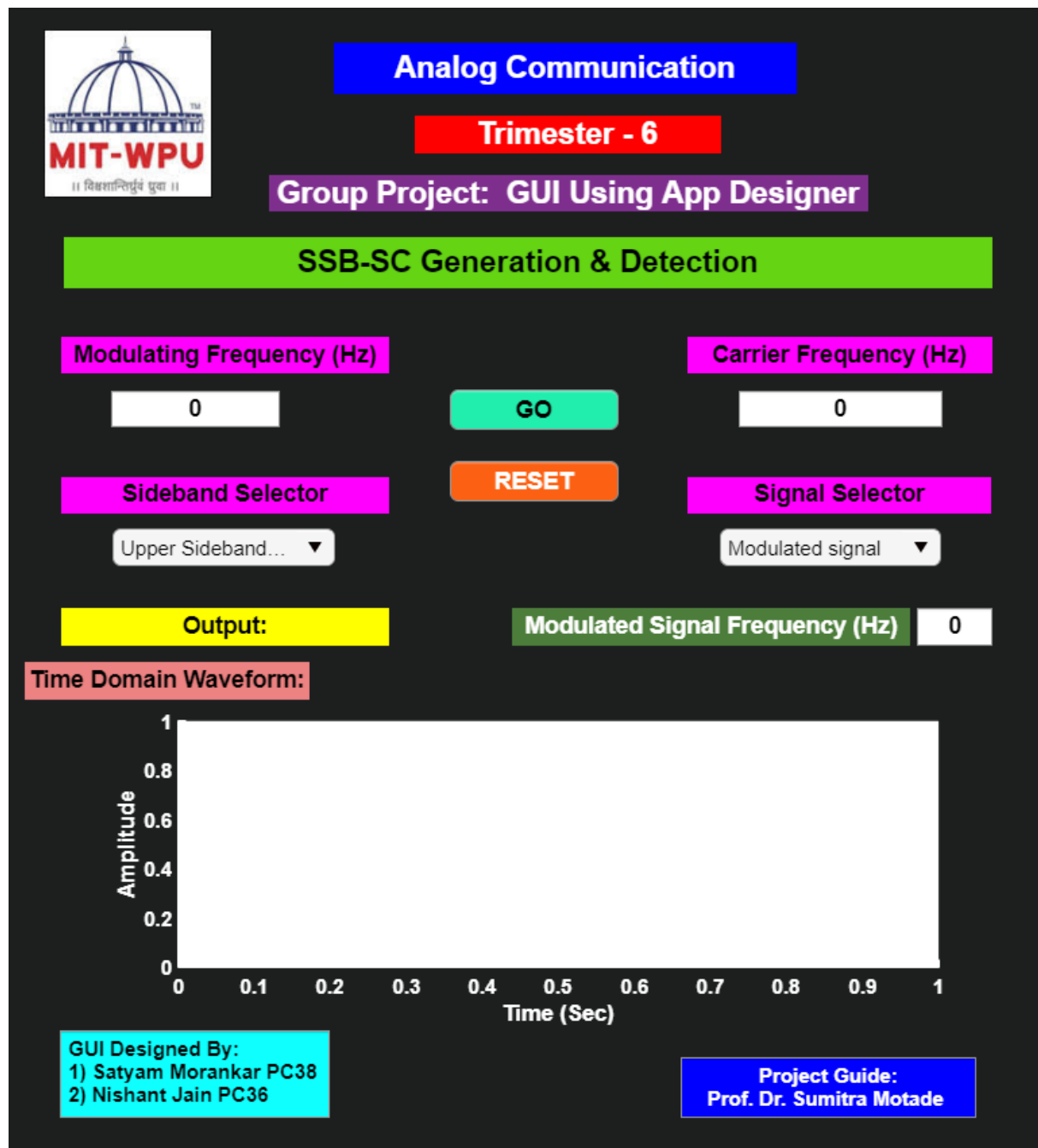
2. Output
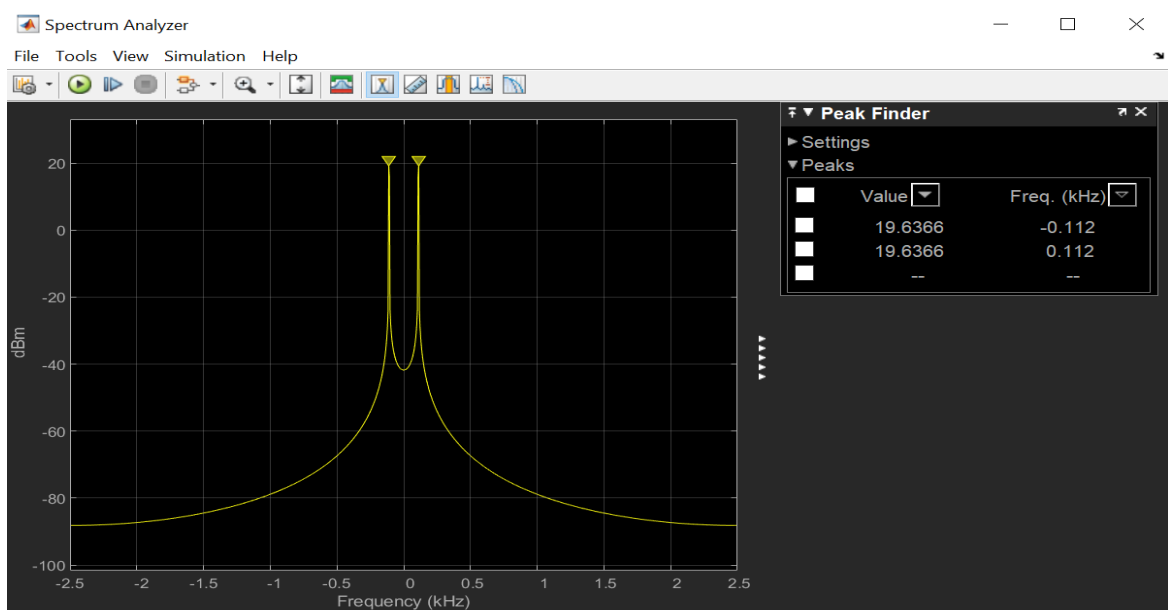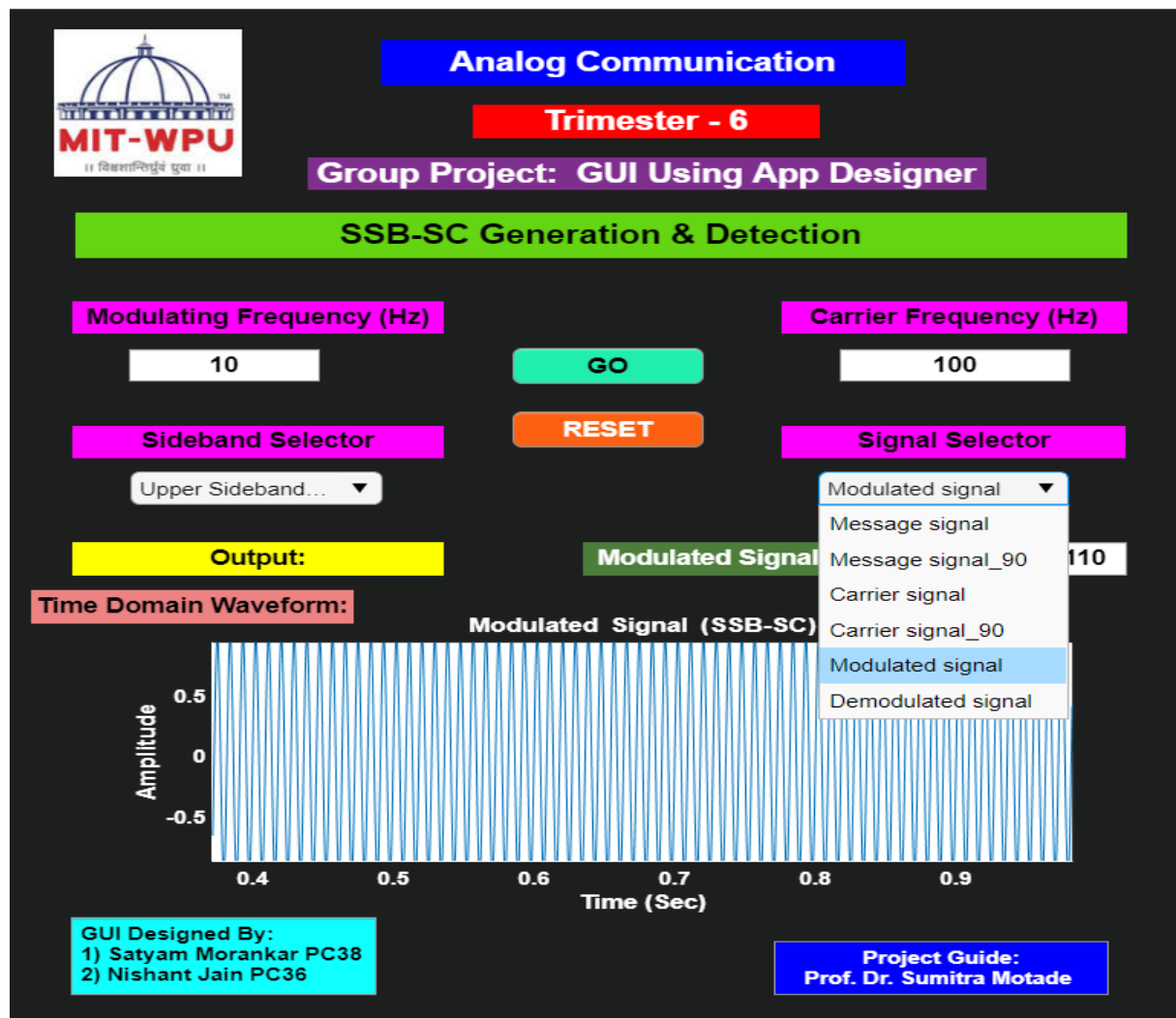
3. Program

```matlab
classdef GUI < matlab.apps.AppBase

    % Properties that correspond to app components
    properties (Access = public)
        ACGroupProjectSSBSCUIFigure     matlab.ui.Figure
        SSBSCGenerationDetectionLabel   matlab.ui.control.Label
        ModulatingFrequencyHzLabel      matlab.ui.control.Label
        EditField                       matlab.ui.control.NumericEditField
        CarrierFrequencyHzLabel         matlab.ui.control.Label
        EditField_2                     matlab.ui.control.NumericEditField
        GOButton                        matlab.ui.control.Button
        SignalSelectorDropDownLabel     matlab.ui.control.Label
        SignalSelectorDropDown          matlab.ui.control.DropDown
        SidebandSelectorLabel           matlab.ui.control.Label
        DropDown                        matlab.ui.control.DropDown
        OutputLabel                     matlab.ui.control.Label
        TextArea                        matlab.ui.control.TextArea
        CarrierFrequencyHzLabel_2       matlab.ui.control.Label
        Image_2                         matlab.ui.control.Image
        AnalogCommunicationLabel        matlab.ui.control.Label
        Trimester6Label                 matlab.ui.control.Label
        GroupProjectGUIUsingAppDesignerLabel  matlab.ui.control.Label
        TextArea_2                      matlab.ui.control.TextArea
        ModulatedSignalFrequencyHzEditFieldLabel  matlab.ui.control.Label
        ModulatedSignalFrequencyHzEditField  matlab.ui.control.NumericEditField
        RESETButton                     matlab.ui.control.Button
        TimeDomainWaveformLabel         matlab.ui.control.Label
        UIAxes_2                        matlab.ui.control.UIAxes
    end

    % Callbacks that handle component events
    methods (Access = private)
```

```matlab
v=app.SignalSelectorDropDown.Value;
if(app.DropDown.Value==1)
assignin('base','mssg',app.EditField.Value);
assignin('base','carr',app.EditField_2.Value);
simout = sim('GUI_SSB_F');
mssg = app.EditField.Value;
carr = app.EditField_2.Value;
app.ModulatedSignalFrequencyHzEditField.Value = mssg+carr;
switch v
case '1'
plot(app.UIAxes_2,simout.Mess_sgnl.time,simout.Mess_sgnl.Data);
t=title(app.UIAxes_2,'\color{white}Message Signal');
t.FontWeight='bold';
case '2'
plot(app.UIAxes_2,simout.Mess_sgnl_90.time,simout.Mess_sgnl_90.Data);
```

```matlab
t=title(app.UIAxes_2,'\color{white}90 degree Phase Shifted Message Signal');
t.FontWeight='bold';
case '3'
plot(app.UIAxes_2,simout.carr_sgnl.time,simout.carr_sgnl.Data);
t=title(app.UIAxes_2,'\color{white}Carrier Signal');
t.FontWeight='bold';
case '4'
plot(app.UIAxes_2,simout.carr_sgnl_90.time,simout.carr_sgnl_90.Data);
t=title(app.UIAxes_2,'\color{white}90 degree Phase Shifted Carrier Signal');
t.FontWeight='bold';
case '5'
plot(app.UIAxes_2,simout.Modulated.time,simout.Modulated.Data);
t=title(app.UIAxes_2,'\color{white}Modulated Signal (SSB-SC)');
t.FontWeight='bold';
case '6'
plot(app.UIAxes_2,simout.Demodulated.time,simout.Demodulated.Data);
t=title(app.UIAxes_2,'\color{white}Demodulated Signal');
t.FontWeight='bold';
end
            else
                assignin('base','mssg',app.EditField.Value);
            assignin('base','carr',app.EditField_2.Value);
            simout = sim('LSB_Spectrum.slx');

            mssg = app.EditField.Value;
            carr = app.EditField_2.Value;
            app.ModulatedSignalFrequencyHzEditField.Value = carr-mssg;

            switch v
                case '1'

plot(app.UIAxes_2,simout.Mess_sgnl.time,simout.Mess_sgnl.Data);
                    t=title(app.UIAxes_2,'\color{white}Message Signal');
                    t.FontWeight='bold';
                case '2'

plot(app.UIAxes_2,simout.Mess_sgnl_90.time,simout.Mess_sgnl_90.Data);
                    t=title(app.UIAxes_2,'\color{white}90 degree Phase Shifted
Message Signal');
                    t.FontWeight='bold';
                case '3'

plot(app.UIAxes_2,simout.carr_sgnl.time,simout.carr_sgnl.Data);
                    t=title(app.UIAxes_2,'\color{white}Carrier Signal');
                    t.FontWeight='bold';
                case '4'

plot(app.UIAxes_2,simout.carr_sgnl_90.time,simout.carr_sgnl_90.Data);
                    t=title(app.UIAxes_2,'\color{white}90 degree Phase
Shifted Carrier Signal');
                    t.FontWeight='bold';
                case '5'
```

```matlab
plot(app.UIAxes_2,simout.Modulated.time,simout.Modulated.Data);
                     t=title(app.UIAxes_2,'\color{white}Modulated Signal
(SSB-SC)');
                     t.FontWeight='bold';
                case '6'

plot(app.UIAxes_2,simout.Demodulated.time,simout.Demodulated.Data);
                     t=title(app.UIAxes_2,'\color{white}Demodulated Signal');
                     t.FontWeight='bold';
            end
            end

        end

        % Button pushed function: RESETButton
        function RESETButtonPushed(app, event)
cla(app.UIAxes_2)
            default = 0;
            app.EditField.Value = default;
            app.EditField_2.Value = default;
            app.ModulatedSignalFrequencyHzEditField.Value = default;
            t=title(app.UIAxes_2,'');
            t.FontWeight='bold';
```

```matlab
        end
    end

    % Component initialization
    methods (Access = private)

        % Create UIFigure and components
        function createComponents(app)

            % Create ACGroupProjectSSBSCUIFigure and hide until all components are created
            app.ACGroupProjectSSBSCUIFigure = uifigure('Visible', 'off');
            app.ACGroupProjectSSBSCUIFigure.Color = [0.1137 0.1216 0.1216];
            app.ACGroupProjectSSBSCUIFigure.Position = [100 100 613 679];
            app.ACGroupProjectSSBSCUIFigure.Name = 'AC Group Project: SSB-SC';

            % Create SSBSCGenerationDetectionLabel
            app.SSBSCGenerationDetectionLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
            app.SSBSCGenerationDetectionLabel.BackgroundColor = [0.3922 0.8314 0.0745];
            app.SSBSCGenerationDetectionLabel.HorizontalAlignment = 'center';
            app.SSBSCGenerationDetectionLabel.FontSize = 18;
            app.SSBSCGenerationDetectionLabel.FontWeight = 'bold';
            app.SSBSCGenerationDetectionLabel.Position = [35 515 551 30];
            app.SSBSCGenerationDetectionLabel.Text = 'SSB-SC Generation & Detection';

            % Create ModulatingFrequencyHzLabel
            app.ModulatingFrequencyHzLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
            app.ModulatingFrequencyHzLabel.BackgroundColor = [1 0 1];
            app.ModulatingFrequencyHzLabel.HorizontalAlignment = 'center';
            app.ModulatingFrequencyHzLabel.FontSize = 14;
            app.ModulatingFrequencyHzLabel.FontWeight = 'bold';
            app.ModulatingFrequencyHzLabel.Position = [34 464 194 22];
            app.ModulatingFrequencyHzLabel.Text = 'Modulating Frequency (Hz)';

            % Create EditField
            app.EditField = uieditfield(app.ACGroupProjectSSBSCUIFigure, 'numeric');
            app.EditField.Limits = [0 100];
            app.EditField.HorizontalAlignment = 'center';
            app.EditField.FontSize = 14;
            app.EditField.FontWeight = 'bold';
            app.EditField.Position = [63 432 100 22];
            app.EditField.Value = 10;

            % Create CarrierFrequencyHzLabel
            app.CarrierFrequencyHzLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
            app.CarrierFrequencyHzLabel.BackgroundColor = [1 0 1];
            app.CarrierFrequencyHzLabel.HorizontalAlignment = 'center';
            app.CarrierFrequencyHzLabel.FontSize = 14;
            app.CarrierFrequencyHzLabel.FontWeight = 'bold';
            app.CarrierFrequencyHzLabel.Position = [406 464 180 22];
            app.CarrierFrequencyHzLabel.Text = 'Carrier Frequency (Hz)';

            % Create EditField_2
            app.EditField_2 = uieditfield(app.ACGroupProjectSSBSCUIFigure, 'numeric');
            app.EditField_2.Limits = [0 2000];
            app.EditField_2.HorizontalAlignment = 'center';
            app.EditField_2.FontSize = 14;
            app.EditField_2.FontWeight = 'bold';
            app.EditField_2.Position = [435 432 121 22];
            app.EditField_2.Value = 100;
```

```matlab
% Create GOButton
app.GOButton = uibutton(app.ACGroupProjectSSBSCUIFigure, 'push');
app.GOButton.ButtonPushedFcn = createCallbackFcn(app, @GOButtonPushed, true);
app.GOButton.BackgroundColor = [0.1294 0.9294 0.6784];
app.GOButton.FontSize = 14;
app.GOButton.FontWeight = 'bold';
app.GOButton.Position = [264 431 100 24];
app.GOButton.Text = 'GO';

% Create SignalSelectorDropDownLabel
app.SignalSelectorDropDownLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.SignalSelectorDropDownLabel.BackgroundColor = [1 0 1];
app.SignalSelectorDropDownLabel.HorizontalAlignment = 'center';
app.SignalSelectorDropDownLabel.FontSize = 14;
app.SignalSelectorDropDownLabel.FontWeight = 'bold';
app.SignalSelectorDropDownLabel.Position = [405 381 180 22];
app.SignalSelectorDropDownLabel.Text = {'Signal Selector'; ''};

% Create SignalSelectorDropDown
app.SignalSelectorDropDown = uidropdown(app.ACGroupProjectSSBSCUIFigure);
app.SignalSelectorDropDown.Items = {'Message signal', 'Message signal_90', 'Carrier signal', '
app.SignalSelectorDropDown.ItemsData = {'1', '2', '3', '4', '5', '6'};
app.SignalSelectorDropDown.Position = [424 350 131 22];
app.SignalSelectorDropDown.Value = '5';

% Create SidebandSelectorLabel
app.SidebandSelectorLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.SidebandSelectorLabel.BackgroundColor = [1 0 1];
app.SidebandSelectorLabel.HorizontalAlignment = 'center';
app.SidebandSelectorLabel.FontSize = 14;
app.SidebandSelectorLabel.FontWeight = 'bold';
app.SidebandSelectorLabel.Position = [34 381 194 22];
app.SidebandSelectorLabel.Text = 'Sideband Selector';

% Create DropDown
app.DropDown = uidropdown(app.ACGroupProjectSSBSCUIFigure);
app.DropDown.Items = {'Upper Sideband (USB)', 'Lower Sideband (LSB)', ''};
app.DropDown.ItemsData = [1 2];
app.DropDown.Position = [64 350 132 22];
app.DropDown.Value = 1;

% Create OutputLabel
app.OutputLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.OutputLabel.BackgroundColor = [1 1 0];
app.OutputLabel.HorizontalAlignment = 'center';
app.OutputLabel.FontSize = 14;
app.OutputLabel.FontWeight = 'bold';
app.OutputLabel.Position = [34 303 194 22];
app.OutputLabel.Text = 'Output:';

% Create TextArea
app.TextArea = uitextarea(app.ACGroupProjectSSBSCUIFigure);
app.TextArea.WordWrap = 'off';
app.TextArea.FontWeight = 'bold';
app.TextArea.BackgroundColor = [0.0588 1 1];
app.TextArea.Position = [33 23 160 52];
app.TextArea.Value = {'GUI Designed By:'; '1) Satyam Morankar PC38'; '2) Nishant Jain PC36'};
```

```matlab
% Create CarrierFrequencyHzLabel_2
app.CarrierFrequencyHzLabel_2 = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.CarrierFrequencyHzLabel_2.BackgroundColor = [1 0 1];
app.CarrierFrequencyHzLabel_2.HorizontalAlignment = 'center';
app.CarrierFrequencyHzLabel_2.FontSize = 14;
app.CarrierFrequencyHzLabel_2.FontWeight = 'bold';
app.CarrierFrequencyHzLabel_2.Position = [405 464 180 22];
app.CarrierFrequencyHzLabel_2.Text = 'Carrier Frequency (Hz)';

% Create Image_2
app.Image_2 = uiimage(app.ACGroupProjectSSBSCUIFigure);
app.Image_2.Position = [12 568 122 100];
app.Image_2.ImageSource = 'GUI_IMG1.jpg';

% Create AnalogCommunicationLabel
app.AnalogCommunicationLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.AnalogCommunicationLabel.BackgroundColor = [0 0 1];
app.AnalogCommunicationLabel.HorizontalAlignment = 'center';
app.AnalogCommunicationLabel.FontSize = 18;
app.AnalogCommunicationLabel.FontWeight = 'bold';
app.AnalogCommunicationLabel.FontColor = [1 1 1];
app.AnalogCommunicationLabel.Position = [195 630 275 30];
app.AnalogCommunicationLabel.Text = 'Analog Communication';
```

```matlab
% Create Trimester6Label
app.Trimester6Label = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.Trimester6Label.BackgroundColor = [1 0 0];
app.Trimester6Label.HorizontalAlignment = 'center';
app.Trimester6Label.FontSize = 18;
app.Trimester6Label.FontWeight = 'bold';
app.Trimester6Label.FontColor = [1 1 1];
app.Trimester6Label.Position = [243 595 182 22];
app.Trimester6Label.Text = 'Trimester - 6';

% Create GroupProjectGUIUsingAppDesignerLabel
app.GroupProjectGUIUsingAppDesignerLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.GroupProjectGUIUsingAppDesignerLabel.BackgroundColor = [0.4941 0.1843 0.5569];
app.GroupProjectGUIUsingAppDesignerLabel.HorizontalAlignment = 'center';
app.GroupProjectGUIUsingAppDesignerLabel.FontSize = 18;
app.GroupProjectGUIUsingAppDesignerLabel.FontWeight = 'bold';
app.GroupProjectGUIUsingAppDesignerLabel.FontColor = [1 1 1];
app.GroupProjectGUIUsingAppDesignerLabel.Position = [157 560 355 22];
app.GroupProjectGUIUsingAppDesignerLabel.Text = 'Group Project:  GUI Using App Designer';

% Create TextArea_2
app.TextArea_2 = uitextarea(app.ACGroupProjectSSBSCUIFigure);
app.TextArea_2.HorizontalAlignment = 'center';
app.TextArea_2.FontWeight = 'bold';
app.TextArea_2.FontColor = [1 1 1];
app.TextArea_2.BackgroundColor = [0 0 1];
app.TextArea_2.Position = [401 23 175 36];
app.TextArea_2.Value = {'Project Guide:'; 'Prof. Dr. Sumitra Motade '};
```

```matlab
% Create ModulatedSignalFrequencyHzEditFieldLabel
app.ModulatedSignalFrequencyHzEditFieldLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.ModulatedSignalFrequencyHzEditFieldLabel.BackgroundColor = [0.298 0.4902 0.2314];
app.ModulatedSignalFrequencyHzEditFieldLabel.HorizontalAlignment = 'center';
app.ModulatedSignalFrequencyHzEditFieldLabel.FontSize = 14;
app.ModulatedSignalFrequencyHzEditFieldLabel.FontWeight = 'bold';
app.ModulatedSignalFrequencyHzEditFieldLabel.FontColor = [1 1 1];
app.ModulatedSignalFrequencyHzEditFieldLabel.Position = [301 303 236 22];
app.ModulatedSignalFrequencyHzEditFieldLabel.Text = 'Modulated Signal Frequency (Hz)';

% Create ModulatedSignalFrequencyHzEditField
app.ModulatedSignalFrequencyHzEditField = uieditfield(app.ACGroupProjectSSBSCUIFigure, 'numeri
app.ModulatedSignalFrequencyHzEditField.HorizontalAlignment = 'center';
app.ModulatedSignalFrequencyHzEditField.FontSize = 14;
app.ModulatedSignalFrequencyHzEditField.FontWeight = 'bold';
app.ModulatedSignalFrequencyHzEditField.Position = [541 303 45 22];

% Create RESETButton
app.RESETButton = uibutton(app.ACGroupProjectSSBSCUIFigure, 'push');
app.RESETButton.ButtonPushedFcn = createCallbackFcn(app, @RESETButtonPushed, true);
app.RESETButton.BackgroundColor = [0.9882 0.3765 0.0706];
app.RESETButton.FontSize = 14;
app.RESETButton.FontWeight = 'bold';
app.RESETButton.FontColor = [1 1 1];
app.RESETButton.Position = [264 388 100 24];
app.RESETButton.Text = 'RESET';

% Create TimeDomainWaveformLabel
app.TimeDomainWaveformLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
app.TimeDomainWaveformLabel.BackgroundColor = [0.9294 0.5098 0.5098];
app.TimeDomainWaveformLabel.HorizontalAlignment = 'center';
app.TimeDomainWaveformLabel.FontSize = 14;
app.TimeDomainWaveformLabel.FontWeight = 'bold';
 app.ModulatedSignalFrequencyHzEditField.Position = [541 303 45 22];

 % Create RESETButton
 app.RESETButton = uibutton(app.ACGroupProjectSSBSCUIFigure, 'push');
 app.RESETButton.ButtonPushedFcn = createCallbackFcn(app, @RESETButtonPushed, true);
 app.RESETButton.BackgroundColor = [0.9882 0.3765 0.0706];
 app.RESETButton.FontSize = 14;
 app.RESETButton.FontWeight = 'bold';
 app.RESETButton.FontColor = [1 1 1];
 app.RESETButton.Position = [264 388 100 24];
 app.RESETButton.Text = 'RESET';

 % Create TimeDomainWaveformLabel
 app.TimeDomainWaveformLabel = uilabel(app.ACGroupProjectSSBSCUIFigure);
 app.TimeDomainWaveformLabel.BackgroundColor = [0.9294 0.5098 0.5098];
 app.TimeDomainWaveformLabel.HorizontalAlignment = 'center';
 app.TimeDomainWaveformLabel.FontSize = 14;
 app.TimeDomainWaveformLabel.FontWeight = 'bold';
 app.TimeDomainWaveformLabel.Position = [12 271 169 22];
 app.TimeDomainWaveformLabel.Text = 'Time Domain Waveform:';
```

```matlab
            % Create UIAxes_2
            app.UIAxes_2 = uiaxes(app.ACGroupProjectSSBSCUIFigure);
            xlabel(app.UIAxes_2, 'Time (Sec)')
            ylabel(app.UIAxes_2, 'Amplitude')
            zlabel(app.UIAxes_2, 'Z')
            app.UIAxes_2.PlotBoxAspectRatio = [3.0989010989011 1 1];
            app.UIAxes_2.FontWeight = 'bold';
            app.UIAxes_2.XColor = [1 1 1];
            app.UIAxes_2.YColor = [1 1 1];
            app.UIAxes_2.BoxStyle = 'full';
            app.UIAxes_2.TitleFontWeight = 'normal';
            app.UIAxes_2.GridColor = [0 0 0];
            app.UIAxes_2.MinorGridColor = [0 0 0];
            app.UIAxes_2.Position = [64 75 499 210];

            % Show the figure after all components are created
            app.ACGroupProjectSSBSCUIFigure.Visible = 'on';
        end
    end
```

```matlab
    % App creation and deletion
    methods (Access = public)

        % Construct app
        function app = GUI

            % Create UIFigure and components
            createComponents(app)

            % Register the app with App Designer
            registerApp(app, app.ACGroupProjectSSBSCUIFigure)

            if nargout == 0
                clear app
            end
        end

        % Code that executes before app deletion
        function delete(app)

            % Delete UIFigure when app is deleted
            delete(app.ACGroupProjectSSBSCUIFigure)
        end
    end
end
```

Signature of Students

Nishant Jain   11/06/2021

                                                      Satyam Morankar