Syllabus for Internship on Digital Signal Processing & its Application

NIELIT
रा.इ.सू.प्रौ.सं

Contact Info:

📞 8904310403

✉ pavan@calicut.nielit.in

Syllabus and timeline:

Internship on Digital Signal Processing and its application (Ultrasound Imaging)

1. Basics of MATLAB and Digital Signal Processing

Day-01 &02 :   Theory: 1 hr   Practicals: 5hrs

Introduction to MATLAB, Basics of MATLAB, basic operations, scripts, live scripts, functions, polynomials, saving workspace variables, loading the data, Input/Output, Structures, cells,

Practicals:

1. Built-in functions, linearly spaced vector generation
2. Scripts vs functions vs live scripts
3. Generation of random signals, sine, traingular waves.
4. Some function examples
5. Saving the variables and loading the data

Day-03 &04: Theory: 1 hr   Practice: 5 hrs.

MATLAB and Signal Processing: plotting graphs, Sub-plots, fourier transforms. Filters, Digital filters, windowing techniques, mean, standard deviation of data.

Practicals:

1. 2-D Plots and subplots
2. different types of plotting options
3. fourier transforms
4. Frequency response of Butterworth filter
5. Comparison of hw(n) of Hanning, Hamming and Blackman windows
6. mean, standard deviation of given data.

Day-05:   Practice:3 hrs

File Handling in MATLAB: reading and writing text files, Saving matlab data in to text file, creating basic user dialog boxes.

Practicals:

1. Reading and writing text data
2. Saving the variable data in to the text file.
3. Creation of simple user dialog box

2. Basics of US Imaging

Day-01 &02 :   **Theory: 1 hr**   **Practicals: 5hrs**

Basics of Sound, Introduction to Ultrasound and Ultrasound Machines.
Frequency, speed, Band width, Time of Flight, Transducer, Radiation, Reflection, refraction, Attenuation, Absorption and scattering. Pulse echo principle.

Practicals:
1. Generation of Multi frequency signal and plotting the signal
2. Adding noise to problem-1 and plotting the signal
3. Ultrasound ranging (pulse echo)

Day-03 &04: Theory: 1 hr   **Practice: 5 hrs.**

Types of Transducers, Ultrasound Beams and focusing, Modes of Ultrasound display, Technical description of ultrasound images (A-mode, B-mode, M-mode)
Field-II introduction, Basics about Ultrasound imaging, Implementation of different probe arrays, Generation of A-mode display.

Practicals:
1. Adding the FIELD-II to MATLAB
2. Creation of 64 element linear array transducer
3. Creration of 2-Dimensional phased array transducer
4. Generation of A-mode display

Day-05:   **Practice:3 hrs**

US B-Mode imaging principles. Frontend and backend processing. Principles of Beamforming, delay and sum beamforming, US receiver processing-envelope detection, dynamic range compression, scan conversion and display.
Linear array, phased array and convex array imaging.

Practicals:
1. Generation of Phased array B-mode imaging display

3. Basics of hands-on GUI development using QT

Day-01 &02 :   **Theory: 1 hr**   **Practicals: 5hrs**

Introduction to Qt and C++, Basics of C++ : Input and Output, Flow controls(if-else, ternary, for-loop), Function overloading, Constructors ,destructors, Inheritance.
Introduction to Qt Creator,Project creation: Qt Console Application, Qt Widgets Application ,Using Qt Documention

Practicals: Practice of some examples on above topics

Day-03 &04: Theory: 1 hr   **Practice: 5 hrs.**

Basic Qt class: Qdebug, Timers, Event handling : Signal and slots connections,
Qt classes: Qobject, Qstring, Qdate, Qtime, QbyteArray, Qlist, Qvector, QsysInfo, Qfile, QtextStream, QUdp Socket

Practicals: Practice of some examples on above topics

Day-05:   Practice:3 hrs
QserialPort, Qt widgets.
Practicals: Practice of some examples on above topics

4. Basics of hands-on GUI development using QT-QML.

Day-01 &02 :   Theory: 1 hr   Practicals: 5hrs
Introduction to QML, Qt creator, QML basics, Qt Quick
Practicals: Practice of some examples on above topics

Day-03 &04: Theory: 1 hr   Practice: 5 hrs.
Design properties, Integration of QT C++ and QML, Image creation
Practicals: Practice of some examples on above topics

Day-05:   Practice:3 hrs
Qpaint, Building a small project
Practicals: Practice of some examples on above topics

5. HMI Development for B-mode and M-mode US Imaging using QT-QML with Intel IPPs

Day-01 &02 :   Theory: 1 hr   Practicals: 5hrs
Artificial phantom generation: Creating objects similar to real-world, Generating the Ultrasound reflected(echo) beamforming signal from the artificial phantom(created object)
Practicals:
   1. Creation of artificial phantom with FIELD-II tool using MATLAB
   2. Saving the beamformed data in to the text files

Day-03 &04: Theory: 1 hr   Practice: 5 hrs.
GUI design and integration of echo signal generated in MATLAB to GUI
Project: Ultrasound (US) GUI design – Part1
Practicals:
   1. Creating the GUI using qt-qml for US B-mode display

Day-05:   Practice:3 hrs
Project: Ultrasound (US) GUI design – Part2
Practicals:
   1. Integration of beamformed data to GUI
   2. Generate B-mode display and M-mode display.