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**SECOND SEMESTER 2020-21**

# Course Handout

16-01-2021

*Course No.* :  *INSTR F419*

## Course Title : Virtual Instrumentation

## Instructor-in-Charge : Dr. Rajesh Kumar Tripathy

1. **Scope and Objective of the Course:**

This course provides the student an exposure to concepts in PC-based instrumentation including principles of graphic system design and concepts in data processing and time-frequency analysis using NI LabVIEW. The experiments in the laboratory are expected to consolidate and complement the learning in the lecture. In the laboratory, students are expected to use NI LabVIEW to develop complex virtual instruments by the end of the course.

**2. Textbooks:**

1. Jovitha Jerome, Virtual Instrumentation Using LabView, PHI Learning Private Limited, 2011

**3. Reference books/Materials**

1. Sanjay Gupta, Joseph John Virtual Instrumentation Using LabView, Tata McGraw Hill, 2nd edition, 2010.
2. Fawwaz T. Ulaby, Michel M. Maharbiz, Cynthia M. Furse, Circuit analysis and design, Michigan Publishing, 2018

**4. Course Plan:**

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| **Lecture No.** | **Learning Objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Course details | Introduction to the Course | Handout itself |
| 2-3 | Virtual Instrumentation Fundamentals | Graphic system design, Design flow, The Virtual Instrument (VI), role of hardware and software, applications in test, control and design | T1 Ch. 1, class Notes |
| 4-5 | Introduction to LabVIEW | Creating a project, adding files, creating a VI, Front panel controls, Block diagram blocks, creating documentation | T1 Ch. 2.1- 2.11, class Notes |
| 6-7 | Mathematical operations using LabView | Addition, subtraction, division, multiplication operations, performing mathematical expressions based on selection | Class notes |
| 8-9 | Random numbers and loop | Random number generation, for loop, stop executing the for loop after a certain condition, while loop, random number generation using for loop and while loop | T1 Ch.4.2,4.4,4.8, Class notes |
| 10-11 | Waveform generation using LabVIEW | Sine wave, square wave, triangular wave and sawtooth wave generation, frequency and amplitude parameters, waveform graph | T1 Ch. 7, and Class notes |
| 12-15 | Hybrid programming using LabView | MATLAB script in LabVIEW, generation of different signals using MATLAB script, convolution, correlation, addition, subtraction, division using LabVIEW | Class notes |
| 16 | Frequency domain analysis using LabVIEW | Spectral analysis using LabVIEW, plot magnitude and phase spectrum for various signals | Class notes |
| 17-18 | AM and FM signals generation using LabVIEW | AM signal generation, DSB-SC signal generation, FM signal generation, frequency domain analysis of AM and FM signals | Class notes |
| 19 | Measurement using LabVIEW | Measurement of parameters such as amplitude, frequency, negative peak, peak to peak amplitude, DC value of signal. | R1 and Class notes |
| 20 | Statistical analysis of LabVIEW | Statistical analysis of signal, mean, variance, kurtosis, skewness, and evaluation of histogram. | Class notes |
| 21-22 | Sorting and searching in an array using LabVIEW | Sorting elements in an array using LabVIEW in ascending and descending orders, searching an element in an array, delete an element at a specified location of an array. | R1 and Class notes |
| 23 | Read and write measurement files in LabVIEW | Basics of file I/O: open/close, read measurement file in LabVIEW, write measurement file in LabVIEW | T1, Ch. 9.7, 9.8,9.10, Class notes |
| 24-25 | Data processing using LabVIEW | Extract portion of a signal, append two dynamic signals, converting dynamic data to waveform data, converting waveform data to array, scaling operation, comparison of signals, evaluate peaks and valleys of a signal | Class notes |
| 26-30 | Filter design using LabVIEW | Evaluation of the transfer function of filter using LabVIEW, pole-zero gain equation, differential equation, filter specification parameters, low-pass, high-pass, band-pass, and band-reject filters using LabVIEW, design of filters using pole-zero method in LabVIEW | Class notes |
| 31-32 | Feature extraction using LabVIEW | Statistical features extracted from a signal using LabVIEW, frequency domain features of the signal using LabVIEW | Class notes |
| 33-34 | Time-Frequency analysis | Time-frequency analysis using LabVIEW, spectrogram of different signals | Class notes |
| 35-38 | LabVIEW applications: heart rate evaluation from ECG | Implementation of Pan Tomkin’s algorithm for the evaluation of heart rate signal from ECG using LabVIEW, Detection of bradycardia and tachycardia from ECG signal using LabVIEW. | Class notes |
| 39-42 | Data acquisition (DAQ) system and LabVIEW | Getting Started with the my DAQ, Measurement Ports, NI ELVISMx Instrument Launcher, Measuring Voltage, Measuring Current, Using the NI my DAQ as a Current Source, Creating Waveforms with the Function Generator (FGEN), Measuring Frequency Response with the Bode Analyzer | R2, Appendix F |

**5. Evaluation Scheme:**

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| **Component** | **Duration** | **Weightage** | **Marks** | **Date** | **Remarks** |
| Mid Sem exam | 90 min | 30% | 90 | 01/03 3.30 -5.00PM | OB |
| Lab assignments and report | During lab hours | 35 % | 105 | During lab hours | OB |
| Comprehensive Exam. | 2 hours | 35 % | 105 | 03/05 FN | OB |

**6. Chamber Consultation Hour:** Through Google meet

**7. Notices: Notices concerning this course will be on CMS.**

**8. Make–up Examination:** Make-up will be given on genuine grounds only. Prior application should be made for seeking the make- up examination.

**9. Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Rajesh Kumar Tripathy

**INSTRUCTOR-IN-CHARGE**