DISCIPLINE SPECIFIC CORE COURSE – 7: Analytical Instrumentation I (INDSC3A)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Analytical Instrumentation I (INDSC3A)	**04**	**02**	**0**	**02**	**Course admission eligibility**	**Basic knowledge of chemistry**

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize with the classification of analytical methods
- To understand the fundamentals of qualitative and quantitative analysis concepts.
- To categorize and understand the principle behind various separation techniques (planar and columns) and their instrumentation.
- To understand the principle, instrumentation and applications of visible and ultraviolet molecular spectroscopy

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the classification of analytical methods
- Comprehend fundamentals of qualitative and quantitative analysis
- Differentiate between principle, instrumentation and operation of PaperChromatography and Thin layer chromatography
- Identify various Column Chromatographic techniques and their instrumentation
- Understand the concept of UV-Visible spectroscopy

SYLLABUS OF DSC-7

UNIT – I **(8 hours)**

Introduction to Analytical methods: Classification of Analytical Methods: Classical and Instrumental, Types of Instrumental Methods, Various sample extraction techniques. Instruments for analysis, Calibration of instrumental methods, Selecting an analytical method

UNIT – II **(7 hours)**

Chromatographic Separation methods: Planar Chromatographic methods: Principle and applications of Paper Chromatography, Thin layer chromatography (TLC) and High-Performance Thin Layer Chromatography (HPTLC).

UNIT – III **(8 hours)**

Column Chromatography: General Description of column chromatography, Classification of Chromatographic Methods, Elution in Column Chromatography, Migration rate of solutes, Band Broadening and column efficiency, Optimization of Column Performance.
Gel Permeation Chromatography (GPC): Principle, Instrumentation and Applications.

UNIT – IV **(7 hours)**

Molecular Spectro-analytical Methods of Analysis: Colorimetry and Spectrophotometry: Introduction, theory: molecular energy levels, types of molecular transitions, Lambert-Beer's Law and limitations, Instrumentation of single beam and double beam instrument.

Practical component: **(60 hours)**

1. Preparation of solutions and buffers.
2. Introduction to the use of Analytical Equipment (Analytical Balance, Volumetric Glassware, pH meter).
3. To extract the spinach pigments using liquid-liquid extraction.
4. Separation of plant pigments by paper chromatography.
5. Separation of food colours by paper chromatography.
6. Separation of pharmaceutical sample mixture using thin layer chromatography.
7. Separation of amino acids/sugar/carbohydrates by Thin Layer Chromatography.
8. Separation of cobalt chloride and Blue Dextran mixture by Gel Permeation Chromatography.
9. To study the effect of various solvents on membrane permeability of beetroot using visible spectroscopy
10. Determination of pKa value for a dye using visible spectroscopy.
11. Spectrometric determination of iron in water samples using double beam spectrophotometer.
12. To identify the given unknown colourless samples using UV spectrophotometer.

Essential/recommended readings

1. H.H. Willard, L.L Merrit, J.A. Dean, F. A. Settle, Instrumental Methods of Analysis, CBS Publishers, 7th edition, 2004.
2. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 7th edition, 2016.
3. James W. Robinson, Eileen Skelly Frame, George M. Frame II, Undergraduate Instrumental Analysis, CRC Press, 7th edition, 2014
4. Vogel's Textbook of Qualitative Chemical Analysis, ELBS, 6th edition 2009.

Suggestive readings

1. W. Kemp, Organic Spectroscopy, ELBS, 3rd Edition, 2019.
2. R.S Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill, 3rd Edition 2015.
3. B.K Sharma, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media, 1st Edition, 2011

Note: **Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

DISCIPLINE SPECIFIC CORE COURSE – 8: Operational Amplifiers and Applications (INDSC3B)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Operational Amplifiers and Applications (INDSC3B)	04	03	0	01	Course admission eligibility	Basics of Analog Electronics- BJT circuits

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide understanding of DC and AC characteristics of operational amplifiers (op-amp)
- Design various filters and oscillators circuits using op-amps
- Study linear and non-linear applications of op-amp
- Design multivibrators and other circuits using op-amp.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the DC and AC characteristics of operational amplifiers (op-amp) and its effect on output, significance of op-amp parameters, and compensation techniques
- Elucidate and design circuits to study linear and non-linear applications of op-amps and special application ICs
- Explain the working of signal generators using op-amp
- Explain and compare the working of multivibrators using general purpose op-amp

SYLLABUS OF DSC- 8

UNIT – I **(11 hours)**

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalanced output, Single input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741).

UNIT – II **(12 hours)**

Op-Amp parameters: input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Op-Amp Circuits: Open and closed loop configuration, Limitations of open loop, characteristics of ideal op-amp, frequency response of op-amp in open loop and closed loop. Non-Inverting & Inverting amplifiers, Summing & Difference amplifiers, Log & antilog amplifiers, Instrumentation Amplifier, Integrator & Differentiator circuit, Voltage to current converter, Current to voltage converter.

UNIT – III **(11 hours)**

Comparators: Basic comparator, Level detector, Schmitt Trigger. Voltage limiters, Signal **Generators:** Phase shift oscillator, Wein bridge oscillator, square wave generator, triangle wave generator, saw tooth wave generator, and Multivibrators using opamp.

UNIT – IV **(11 hours)**

Signal conditioning circuits: Sample and hold systems, Active filters: Low pass and high pass Butterworth filter (first and second order), Band pass filter, Band reject filter, and All pass filter.

Practical component: **(30 hours)**

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a first order low-pass filter using op-amp and study its frequency response.
7. Designing of a first order high-pass filter using op-amp and study its frequency response.
8. Designing of a RC phase shift oscillator using op-amp.
9. Design an astable multivibrator using opamp.
10. Design a schmitt trigger circuit using op-amp and study its hysteresis loop.

Essential/recommended readings

1. R. A. Gayakwad, Op-Amps and Linear Integrated circuits, Pearson Education, 4th Edition, May 2015.
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, 6th Edition, Aug 2000, Pearson,
3. Pearson Education (2001).J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill, (2001).

Suggestive readings

1. A.P.Malvino, David J Bates, Electronic Principals, 7th Edition, Tata McGraw-Hil Education, (July 2017).

DISCIPLINE SPECIFIC CORE COURSE – 9: Mathematical Techniques for Instrumentation (INDSC3C)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/ Practice		
Mathematical Techniques for Instrumentation (INDSC3C)	**04**	**03**	**0**	**01**	**Course admission eligibility**	**Basic knowledge of mathematics**

Learning Objectives

The Learning Objectives of this course are as follows:

- To give an ability to apply knowledge of mathematics to engineering problems.
- To introduce the basic concepts required to understand, construct, solve and interpret
- differential equations.
- To teach methods to solve differential equations of various types.
- To teach students to understand the Laplace transform method to solve ordinary differential equations.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Recognize ODEs of varying order and use these to solve engineering problems.
- Derive mathematical models of physical systems.
- Solve the most common PDEs, recurrent in engineering using standard techniques.
- Demonstrate the utility of Laplace transform in solving the ordinary differential equations

SYLLABUS OF DSC-8

UNIT – I **(12 hours)**

Ordinary Differential Equations: First Order Ordinary Differential Equations, Separable Ordinary Differential Equations, Exact and Non-Exact Differential Equations, Linear Ordinary Differential Equations. Linear Independence and Dependence, Linear Differential Equations of Second Order with Constant Coefficients and Variable Coefficients: Homogeneous and non-homogeneous.

Method of Variation of Parameters, Electric Circuits (RL, RC and RLC circuits).

UNIT – II **(11 hours)**

Partial Differential Equations: Formation of Partial Differential Equation, Partial Differential Equation of First Order: Linear and Non-linear. Method of Separation of Variables. Classification of Partial Differential Equations of Second Order, One-dimensional Heat equation, Modeling a Vibrating string and the Wave Equation.

UNIT – III **(11 hours)**

Laplace Transform: Laplace Transform and its properties, Convolution theorem, Laplace Transform of Periodic function, Inverse Laplace transforms and its properties. Application of Laplace Transform to Differential Equations with Constant Coefficients, Solution to System of Simultaneous Differential Equations.

UNIT – IV **(11 hours)**

Fourier series and Transforms: Fourier Series: Even and Odd functions, Half range expansions, Fourier Integral, Fourier Transforms: Fourier Sine and Cosine Transforms, Forced Oscillations.

Practical component: **(30 hours)**

1. Plot the trigonometric functions like sin (x), cos(x), tan(x).
2. Plot the following algebraic expressions log(x), exp(x), x^2, x^3, $x+x^2+\exp(x)$.
3. Plot the following unit step functions u(t), u(t-4) and u(t+2).
4. Solve the first-order ordinary differential equations.
5. Solve the linear differential equation of second order with constant coefficients.
6. Solve the linear differential equation of second order with variable coefficients.
7. Evaluate the Laplace Transform of a given function.
8. Evaluate the inverse Laplace transform of a given function.
9. Evaluate the Fourier series coefficients of a given function.
10. Computing the Fourier Transform of a given signals.

Essential/recommended readings

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition (2020).
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing ,7th Edition.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 43rd Edition (2017).
4. HK Dass, Higher Engineering Mathematics, S.Chand Publishing,22nd Edition.

Suggestive readings

1. Dennis G.Zill,Advanced Engineering Mathematics, Jones & Bartlett Publishers,6th Edition (2016).
2. John Bird**,** Higher Engineering Mathematics,2017

DISCIPLINE SPECIFIC ELECTIVE COURSE – 1: Signal and Systems (INDSE3A)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Signal and Systems (INDSE3A)	04	03	0-	01	Course admission eligibility	Basic knowledge of mathematics

Learning Objectives

The Learning Objectives of this course are as follows:

- To give information about signals and systems mathematically and perform mathematical operations on signals.
- To teach the properties and the response of the LTI system using convolution.
- To give knowledge about Laplace transform, Fourier Transform and Z-transform for analysing continuous-time and discrete-time signals and systems.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basic concept and types of signals and systems and their properties which is useful to learn digital tele-communication
- Classify systems based on their properties and determine the response of LTI system using convolution
- Understand how to apply the Laplace transform, Fourier Transform and Z-transform for analyzing continuous-time and discrete-time signals and systems

SYLLABUS OF DSE-1

UNIT – I **(12 hours)**

Signals and Systems: Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and Unit step functions, Continuous-Time and Discrete-Time Systems.

UNIT – II **(11 hours)**

Linear Time-Invariant Systems (LTI): Continuous & discrete time LTI systems, Convolution Sum, Convolution integral, Properties of LTI Systems: Commutative, Distributive and Associative. LTI systems with and without memory, Invariability, Causality, Stability.Unit Step response of System, Differential and Difference equation formulation, Block diagram representation of first order systems.

UNIT – III **(11 hours)**

Sampling: The Sampling Theorem and its implications. Spectra of sampled signals.
Laplace Transform: Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

UNIT – IV **(11 hours)**

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.
Z-transform: properties, transfer function representation, inverse Z transform of rational functions- transform of input/output difference equation, stability of discrete time systems- frequency response of discrete time systems.

Practical component: **(30 hours)**

Learning Scilab/MATLAB (Experiments based on available systems).
Exploration of Signals and Systems using Scilab/MATLAB.

1. Generation of Signals: continuous time
2. Generation of Signals: discrete time
3. Addition, multiplication, folding and reversal of signals.
4. Convolution of Signals.
5. Solution of Difference equations.
6. Introduction to SIMULINK and calculation of output of systems represented by block diagrams.
7. Determination of Fourier Series coefficients of the given signals.
8. Determination of Fourier transform of the given signals.
9. Determination of Z transform of the given signals

Essential/recommended readings

1. H. P. Hsu, Signals and Systems, 4th Edition Tata McGraw Hill (2019).
2. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, 4th EditionOrchard Publications (2008).
3. W. Y. Young, Signals and Systems with MATLAB, Springer (2014).
4. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2010).

Suggestive readings

1. Alan V. Oppenheim, Alan S. Willsky with S. Hamid, Signals and Systems, 2nd edition, Pearson, Inc. (2022).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE – 2: VHDL Programming(INDSE3B)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
VHDL Programming (INDSE3B)	04	02	0	02	Course admission eligibility	Understanding of Digital Electronics

Learning Objectives

The Learning Objectives of this course are as follows:

- To develop the basic understanding of VHDL Modules, entity and architectures.
- To familiarize with different VHDL elements, Keywords and Identifiers
- To describe hardware in VHDL using different Modeling styles.
- To understand concurrent and sequential assignments.
- To introduce built in primitive gates and understand Gate level Modelling

Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn about HDL Modules and simulation tools.
- Apply the knowledge of entity, architectures, VHDL Modules to describe hardware.
- Write and analyze various VHDL codes for combinational and sequential logic circuits
- describe hardware using multiple modeling styles.

SYLLABUS OF DSE-2

UNIT – I **(8 hours)**

Introduction to VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, VHDL requirements, VHDL basic language elements, Keywords, Identifiers, White Space Characters, Comments, format, VHDL operators.

VHDL Modeling: Describing hardware in VHDL, entity, architectures, VHDL Modules, Delays, data flow style, behavioural style, structural style, mixed design style, simulating design.

UNIT – II **(8 hours)**

BehavioralModeling: Introduction to behavioural modelling, Signal assignment,

Concurrent and sequential assignments., Entity Declaration, Architecture Body, BehavioralModeling, Process statement, Loop control statements, Multiple Processes, Delay Models, inertial delay model, transport delay model, transport vs inertial delay, Signal Drivers.

UNIT – III **(7 hours)**

Dataflow and Structural Modeling: Data flow Modeling, Concurrent Assignment statements, Block statements, Structural Modeling, Component declaration and Instantiation, generate statements, Process, IF, CASE, LOOP, NEXT, EXIT and ASSERT statements.

UNIT – IV **(7 hours)**

Gate level modeling: Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

Practical component: **(60 hours)**

Learning Scilab/MATLAB (Experiments based on available systems).
Exploration of Signals and Systems using Scilab/MATLAB.

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4-bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 3-bit Ripple counter.

Essential/recommended readings

1. J. Bhasker, VHDL Primer, Pearson, 3rd edition ,2015.
2. Volnei. A.Pedroni, Circuit Design with VHDL, MIT Press; Third edition, 2020
3. Sudhakar Yalamanchili, Introductory VHDL-From Simulation to Synthesis, Pearson Education India. First Edition, 2000

Suggestive readings

1. Douglas Perry, VHDL, McGraw-Hill Education; 4th edition, 2002
2. Charles.H.Roth, Digital system Design using VHDL, Cengage; 2nd edition, 2012

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE – 3: Programming using MATLAB(INDSE3C)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Programming Using MATLAB (INDSE3C)	04	02	0	02	Course admission eligibility	Basic knowledge of mathematics

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize the student with MATLAB software.
- The objective of this lab is to introduce students to the basic operations of MATLAB.
- To enable the student on how to approach solving Engineering problems using simulation tools.
- To prepare the students to use MATLAB in their project works.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Use MATLAB for interactive computations
- Generate plots and exports them for use in reports
- Familiar with inbuilt MATLAB functions and will be able to generate user defined functions for various applications
- Understands fundamental of digital image and signal processing

SYLLABUS OF DSE-3

UNIT – I **(8 hours)**

Introduction to MATLAB: MATLAB Features, MATLAB Windows, defining variables, variable naming, checking existence, different Operations on variables, clear Operations, data type, precedence, scalar, vectors and Arrays.

UNIT – II **(7 hours)**

Data and Data Flow in MATLAB: Operators in MATLAB, Matrix operations, Reshaping Matrices, Importing & Exporting of Data, Arrays, Data types, File Input-Output, Communication with External Devices.

Character and Strings: Defining character and string, accessing character or substring

from string, string concatenation and comparing, conversion between strings and number. Defining and working with Multidimensional Array and Cell arrays.

UNIT – III **(7 hours)**

Programming: Writing Script Files and Functions files, Error Correction, M-Lint Automatic Code Analyzer, Saving Files. Flow control statement: Conditional or selection, error handling, loop control, program termination. Solution of simultaneous linear equations.

UNIT – IV **(8 hours)**

MATLAB Graphics: Simple Graphics, Graphic Types, Plotting Functions, Creating Plot & Editing Plot, multiple plots, labeling graph, line colors, style and Marker. Introduction of Graphical User Interface (GUI), Generation and implementation of various functions on image.

Practical component: **(60 hours)**

1. Define variables, create a matrix of any size with all possible methods and perform various mathematical operations.
2. Create a multidimensional array and delete any Row/Column from it and create a new array.
3. Plot and label trigonometric functions using subplot command.
4. Generate various kinds of continuous and discrete time signals. Perform time scaling, time shifting and amplitude scaling on them.
5. Generate the (i) square wave and (ii) triangular wave of a specific amplitude and time period and plot it on a single graph.
6. Create a function which compares any two strings of equal length and return 'M' for matched character and 'U' for unmatched Character. Also display the number of characters matched.
7. Generate the (i) square wave and (ii) triangular wave of a specific amplitude and time period and plot it on a single graph.
8. Write a script to test whether a user defined no. is Prime or not.
9. Write a script which can evaluate the percentage (%) and grade of the student when subject marks are entered by the user.
10. Create a function which compares any two strings of equal length and return 'M' for matched character and 'U' for unmatched Character. Also display the number of characters matched.
11. Write a function to generate the AP series.
12. Write a function to generate the GP series.
13. Write a function to generate the Fibonacci series.
14. Write a function to generate the amplitude and frequency modulated signal.

Essential/recommended readings

1. Khanna, M., Bhatt, G. and Kumar, P., MATLAB Essentials for Problem Solving, (2019) PHI Learning, New Delhi.
2. Fausett, L. V., Applied Numerical Analysis Using MATLAB, (2005) Prentice Hall, Upper Saddle River, New Jersey.
3. Linfield, G. & Penny, J., Numerical methods using MATLAB, (2019) Ellis-Horwood.

Suggestive readings

1. Nakamura, S., Numerical Analysis and Graphic Visualization with MATLAB - Second Edition, Prentice Hall PTR, Upper Saddle River, New Jersey

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY THE DEPARTMENTS

GENERIC ELECTIVES (GE-3):

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Virtual Instrumentation (INGE3A)	04	02	0	02	Course admission eligibility	Basic knowledge Electronics

Learning Objectives

The Learning Objectives of this course are as follows:

- To study the basic structure of virtual instrumentation
- To learn the basic programming concepts in LabVIEW
- To understand the basics of data acquisition for designing a Virtual Instrument

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the importance and applications of Virtual Instrumentation
- Learn the basic programming concepts in LabVIEW
- Recognize the components of Virtual instrumentation and use them for PC Based measurement

SYLLABUS OF GE-3

UNIT – I **(8 hours)**

Graphical System Design: Graphical system design model, Design flow with GSD,

Virtual Instrumentation, Virtual instrument, and traditional instrument, Hardware and software in virtual instrumentation, Virtual instrumentation for Test, control & design, Graphical system design using LABVIEW, Graphical programming & textual programming.

UNIT – II **(7 hours)**

LabVIEW Basics: Introduction, advantages of LABVIEW software environment, palettes, front panel controls & indicators, Block diagram, Data flow program. Repetition and Loops: For loops, while loops, structure tunnels, terminals inside or outside loops, shift registers, feed-back nodes, control timing, case structure.

UNIT – III **(8 hours)**

Arrays and Clusters: Arrays, Introduction, arrays in LABVIEW, creating one – dimensional array controls, indicators, and constants, creating two-dimensional arrays, creating multidimensional arrays, initializing array, deleting, inserting, and replacing elements, rows, columns, and pages within arrays, arrays functions. Clusters: Cluster controls and indicator, order of cluster elements, Cluster operations.

Plotting Data: Types of waveforms, waveform graphs, waveform charts, XY graphs, Intensity graphs & charts, Digital waveform graphs, 3D graphs, customizing graphs & charts, configuring a graph or chart, Displaying special planners on the XY graph.

UNIT – IV **(7 hours)**

File Input/ Output: File formats, file write &read, generating filenames automatically, String handling,string functions, LABVIEW string formats, parsing of strings. Instrument Control: Introduction, GPIB communication, Hardware specification, software architecture, Instrument I/O assistant, VISA, Instrument drivers, serial port communications, using other interfaces.

Practical component: **(60 hours)**

1. Build a VI to compute the expressions Y = (A*B*C) + (D*E) and Y = mx + c.
2. Split an input string into two outputs with reference to a separating character. Find the length of the input string and reverse the string.
3. Build a VI to perform various Boolean Operations (AND, OR, NAND, NOR, XOR).
4. Write a program in LabVIEW to find whether the given number is odd or even.
5. Create a VI to find the sum of first n natural numbers using a While Loop with a feedback node.
6. Create a VI to compute full adder logic using half adder logic as subVI.
7. Write a program in LabVIEW to find the square of the numbers from 1 to 100 using (a) a For Loop and (b) a While Loop.
8. Create a VI to compare the element of two clusters if the value of the corresponding elements are the same switch on LED in the output cluster.
9. Create a VI to compare clusters and Switch ON an LED in the output cluster if the nth element of cluster 1 is greater than the nth element of cluster 2.
10. Create a 2D numeric array (5 x 5) containing random numbers and find its transpose.
11. Create a VI to read a two-dimensional array and find the sum of the elements

in the row-wise and column-wise separately and display the sums of the rows and columns.

12. Create a 1D array and find its reverse.
13. Build a VI to plot a circle in the XY graph using a For Loop.
14. Build a VI that generates a 1D array of random numbers and sort the ascending descending array and also find the max. and min. value array element.
15. Build a cluster control that consists of a seven-segment LED display, a switch, a string control, and numeric control. Split the cluster elements using the Unbundle function and alter the values of some of the cluster controls. Bundle them again and display in a cluster indicator.
16. Using For loop determine the number of odd numbers between a range of numbers entered by the user.
17. Build a VI to plot different colors in an intensity graph using an array.
18. Create a VI to check whether the cluster elements are in range or not. Specify the upper and lower limits. Display the coerced output and a cluster of LEDs to indicate whether a particular cluster element is in the range or not.
19. Write a program to solve x2+bx+c=0.
20. Build a VI to generate two waveforms of different amplitude and frequencies add the signal to find the resultant and plot it on a separate waveform graph.
21. Create a VI to read a two-dimensional array and find the sum of the elements in the row-wise and column-wise separately and display the sums of the rows and columns.

Essential/recommended readings

1. Jovitha Jerome,Virtual Instrumentation Using Labview,PHI Learning Pvt. Ltd. (2010)
2. John Essick, Hands-on Introduction to LabVIEW for Scientists and Engineers, 3rd Edition, 2015.
3. Gupta, Virtual Instrumentation Using Labview 2E, McGraw Hill. (2010)

Suggestive readings

1. Jeffrey Travis, LabVIEW for everyone, Prentice-Hall PTR,2007.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-3): Industrial and environmental techniques (INGE3B)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/		

				Practice		
Industrial and environmental techniques (INGE3B)	**04**	**02**	**0**	**02**	**Course admission eligibility**	**Basic knowledge of chemistry or analytical chemistry**

Learning Objectives

The Learning Objectives of this course are as follows:

- Demonstration of a clear and exhaustive understanding of the basic concepts of Industrial analysis of different industrial products.
- Impart theoretical and practical knowledge of Analysis of food and food products
- Learn analysis of various pharmaceutical drugs as per the standard pharmacopeia
  To expose to different types of Environmental pollutants and their analysis:

Learning outcomes

The Learning Outcomes of this course are as follows:

- Identify the key environmental factors shaping an industry
- Demonstrate ability to use tools and methodologies for performing analysis for various types of industries
- Develop a detailed professional report of Industry Analysis conducted.

SYLLABUS OF GE-3

UNIT – I **(8 hours)**

Industrial analysis

Paints: Definition, constituents and their functions, flash point of paints, separation of pigments, binder and thinner. Analysis of vehicle and thinner.

Pigments: General outline of identification and analysis of pigments -organic and inorganic pigments, their qualitative chemical test, analysis of white and tinted pigments.

Pesticides: Definition and classification of pesticides, analysis of the following in outline – DDT, Malathion, Diagionon.

Alloys: Composition and estimation of main constituents in in the following – Stainless steel, Brass, Solder and Gun metal

Rubber and Polymers: Mechanical, Thermal, Electrical and Optical properties, Analysis and Characterization.

UNIT – II **(8 hours)**

Analysis of food and food products

Composition and analysis of the following: Milk- Specific gravity, total solid, fat, proteins, lactose, contaminants in milk (QAS, artificial color and antibiotic), Wheat flour- Moisture, ash, oil, fat, protein, fiber, acidity, starch and maltose. Beverages-

Alcohol contents. Tea- Moisture, ash, tannin and caffeine. cyclamate. Honey- Moisture, HMF, Free acid, pH and carbohydrate.

UNIT – III **(7 hours)**

Pharmaceutical analysis

Drug, classification of drugs, introduction to Indian pharmacopoeia. Analysis of following drugs as per IP and BP (monograms) - Amoxycillin, Analgin, Proponolol, Pilocarbine nitrate, Rifampicin, Paracetamol, Nimuselide, Ranitidine.

UNIT – IV **(7 hours)**

Environmental analysis

Analysis of water- color, Odor, pH, taste, conductivity, dissolved solid, hardness, DO, COD, BOD, chlorides, sulphates, nitrites and phosphates.

Analysis of air- Sampling, particulate matter, gaseous pollutants-SOX, NOX, COX and organic pollutant

Practical component: **(60 hours)**

1. Determination of physical parameters of wastewater: pH, color, conductivity and Oxidation reduction potential.
2. Determination of dissolved oxygen in given water sample.
3. Estimation of phosphorous in fertilizer
4. Determination of calcium in cement sample (Titrimetry)
5. Estimation of calcium and Magnesium in dolomite ore.
6. Analysis of water for COD.
7. Colorimetric estimation of trace of nitrogen in the given water sample using Nessler's reagent.
8. Analysis of tea and coffee.
9. Determination of refractive index of given edible oil/solvents and determine its percentage purity.
10. Determination of Ascorbic acid.
11. Colorimetric estimation of Rifampicin (IP 1996)
12. Assay of Aspirin.
13. Estimation of specific gravity and total solids present in milk samples.
14. Estimation of lactose content of milk.
15. Determination of glucose in honey.
16. Quality assessment of Rubber/polypropylene/polyethylene samples

Essential/recommended readings

1. Analytical chemistry: an introduction: D. A. Skoog, D. M. West and F. J. Holler, Saunders the College publishers, 6th edition.
2. Vogel's Textbook of Qualitative Chemical Analysis, ELBS, 6th edition 2009.
3. Indian Pharmacopeia (2018)
4. A.B. Mathur and I.S. Bhardwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt Limited, 2003
5. Rao, E. S. (2013). Food Quality Evaluation (I ed.). New Delhi: Variety Book Publishers.
6. DeMan. (2007). Principles of Food Chemistry. Springer, 3rdedition.

Suggestive readings

1. Rao, E. S. (2013). Food Quality Evaluation (I ed.). New Delhi: Variety Book Publishers.
2. DeMan. (2007). Principles of Food Chemistry. Springer, 3rd edition.
1.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.