



An MoE Govt of India Initiative

VIRTUAL LAB MANUAL

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JIIT, Noida



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Jaypee Institute of Information Technology (JIIT) Noida is a Nodal center of Virtual labs. All virtual labs can be used remotely & provide a very easy and effective way of learning. Most of the experiments are simulation and animation based and thus provides a good insight of the concepts.

Web address of Virtual lab is:

<https://www.vlab.co.in/>

Virtual lab (VLab) is An Initiative of Ministry of Education, India Under the National Mission on Education through ICT.

Objectives of VLab

1. To provide remote-access to Labs in various disciplines of Science and Engineering. These Virtual Labs would cater to students at the undergraduate level, post graduate level as well as to research scholars.
2. To enthuse students to conduct experiments by arousing their curiosity. This would help them in learning basic and advanced concepts through remote experimentation.
3. To provide a complete Learning Management System around the Virtual Labs where the students can avail the various tools for learning, including additional web-resources, video-lectures, animated demonstrations and self-evaluation.
4. To share costly equipment and resources, which are otherwise available to limited number of users due to constraints on time and geographical distances.

Broad Areas of Virtual Labs

1. Electronics & Communications
2. Computer Science & Engineering
3. Electrical Engineering
4. Mechanical Engineering
5. Chemical Engineering
6. Biotechnology and Biomedical Engineering
7. Civil Engineering
8. Physical Sciences
9. Chemical Sciences

Labs available on VLab portal are developed by following prestigious institutes:

1. IIT KHARAGPUR
2. IIT ROORKEE
3. IIT GUWAHATI
4. IIT DELHI
5. IIT BOMBAY
6. IIT KANPUR
7. IIT MADRAS
8. IIIT HYDERABAD
9. NIT KARNATAKA
10. AMRITA VISHWA VIDYAPEETHAM
11. DAYALBAGH EDUCATIONAL INSTITUTE

Although using Vlabs is very easy and no special training is needed, you may refer the official you tube channel also for ready reference

<https://youtube.com/channel/UCVQxv8XC-hICS6Ju1HqGeHA>

Students of IIIT Noida are using VLab from last two years and are encouraged to explore and perform as many as labs as possible, from Vlab within and beyond their defined curricula. To provide a quick reference to what is available and its depth, department wise annexure are attached to provide the details as follows:

- Annexure-1 :Virtual labs on Subjects and List of experiments of CSE & IT department (*Compiled by Dr. DharmveerRajpoot& Mrs. VarshaGarg*)
- Annexure-2 : Virtual labs on Subject and List of experiments of ECE department (*Compiled by Dr. Neetu Singh & Dr. KapilTyagi*)
- Annexure-3 :Virtual labs on Subject and List of experiments of Biotech department (*Compiled by Dr. Smriti Gaur& Dr. Chakresh Jain*)
- Annexure-4 :Virtual labs on Subject and List of experiments of PMSE department (*Compiled by Dr. AnurajPanwar& Dr. Dinesh Tripathi*)

Virtual labs available belonging to the subjects of area of Computer science and IT

By the end of December 2020, there are total 20 subjects virtual labs are available. These subjects can be found at:

<https://www.vlab.co.in/broad-area-computer-science-and-engineering>.

All of these labs have been developed by prestigious engineering institutes of India. The details of list of experiments under each of these subjects are mentioned from next page.

1. Basics of HTML Lab by IIT DELHI
[<https://html-iitd.vlabs.ac.in/>]
2. Soft Computing Tools in Engineering Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/scte/>]
3. Problem Solving Lab by IIIT HYDERABAD
[<http://ps-iiith.vlabs.ac.in/>]
4. Data Structures - I by IIIT HYDERABAD
[<https://ds1-iiith.vlabs.ac.in/data-structures-1/>]
5. Data Structures - II by IIIT HYDERABAD
[<https://ds2-iiith.vlabs.ac.in/data-structures-2/>]
6. Artificial Neural Networks Lab by IIIT HYDERABAD
[<http://cse22-iiith.vlabs.ac.in/>]
7. Pattern Recognition Lab by IIIT HYDERABAD
[<http://cse20-iiith.vlabs.ac.in/>]
8. VLSI Lab by IIIT HYDERABAD
[<http://cse14-iiith.vlabs.ac.in/>]
9. Computer Architecture & Organization Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/coa/>]
10. Software Engineering Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/se/>]
11. Data Structures Lab by IIIT HYDERABAD

[<http://cse01-iiith.vlabs.ac.in/>]

12. Computer Programming Lab by IIIT HYDERABAD

[<http://cse02-iiith.vlabs.ac.in/>]

13. Computer Organization Lab by IIIT HYDERABAD

[<http://cse11-iiith.vlabs.ac.in/>]

14. Speech Signal Processing Lab by IIIT HYDERABAD

[<http://ssp-iiith.vlabs.ac.in/>]

15. Computer Graphics Lab by IIIT HYDERABAD

[<http://cse18-iiith.vlabs.ac.in/>]

16. Image Processing Lab by IIIT HYDERABAD

[<http://cse19-iiith.vlabs.ac.in/>]

17. Computational Linguistics Lab by IIIT HYDERABAD

[<http://cl-iiith.vlabs.ac.in/>]

18. Natural Language Processing Lab by IIIT HYDERABAD

[<http://nlp-iiith.vlabs.ac.in/>]

19. Wireless Sensor Network Lab by AMRITA VISHWA VIDYAPEETHAM

[<http://vlab.amrita.edu/index.php?sub=78>]

20. Cryptography Lab by IIIT HYDERABAD

[<http://cse29-iiith.vlabs.ac.in/>]

Details of experiments under each subject:

1. Basics of HTML Lab by IIT DELHI [<https://html-iitd.vlabs.ac.in/>]

- a) Introduction to HTML
- b) Applying Attributes in HTML Tags
- c) Inserting images through img tags
- d) Using Anchor Tags for Hyperlinks
- e) How marquee Tags work in HTML
- f) Creating Tables in HTML
- g) Types of Lists in HTML
- h) Working of div Tag in HTML
- i) Embedding through iframe Tag
- j) Creating Webpage Layout in HTML

2. Soft Computing Tools in Engineering Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/scte/>]

- a. Fuzzy Logic Fundamentals and Basic Operations
- b. Fuzzy Inference System(FIS)
- c. Fuzzy Weighted Average
- d. Fuzzy Control
- e. Neural Networks and Perceptron
- f. Multilayer Perceptron
- g. Radial Basis Function
- h. Probabilistic Neural Networks
- i. Introduction to EA
- j. Binary and Real Coded genetic Algorithms
- k. Genetic Expression Programming
- l. Introduction to Probabilistic Reasoning and Bayesian Networks Application

3. Problem Solving Lab by IIIT HYDERABAD [<http://ps-iiith.vlabs.ac.in/>]

- a. Numerical Representation
- b. Beauty of Numbers
- c. More on Numbers
- d. Factorials
- e. String Operations
- f. Recursion
- g. Advanced Arithmetic
- h. Searching and Sorting
- i. Permutation
- j. Sequences

4. Data Structures - I by IIIT HYDERABAD [<https://ds1-iiith.vlabs.ac.in/data-structures-1/>]

Sorting

- Bubble Sort
- Merge Sort
- Heap Sort
- Quick Sort

Graphs

- Depth First Search
- Breadth First Search

Trees

- Tree Traversal
- Binary Search Trees

Stacks and Queues

- Stacks and Queues
- Infix to Postfix

Searching

- Unsorted Arrays
- Hashtables

Linked Lists

- Linked lists
- Polynomial Arithmetic using linked lists

5. Data Structures - II by IIIT HYDERABAD [<https://ds2-iiith.vlabs.ac.in/data-structures-2/>]

Sorting- Selection Sort, Radix Sort

Graphs- Topological Sort, Minimum Spanning Trees, Path algorithms: Dijkstra's shortest path

Search Trees- 2-3 Tree, Red Black Tree

Strings- Tries and Suffix Trees, Substring search: KMP algorithm

6. Artificial Neural Networks Lab by IIIT HYDERABAD [<http://cse22-iiith.vlabs.ac.in/>]

- Parallel and distributed processing - I: Interactive activation and competition models
- Parallel and distributed processing - II: Constraint satisfaction neural network models
- Perceptron learning
- Multilayer feedforward neural networks
- Hopfield model for pattern storage task
- Hopfield model with stochastic update
- Competitive learning neural networks for pattern clustering
- Solution to travelling salesman problem using self organizing maps
- Solution to optimization problems using Hopfield models
- Weighted matching problem: Deterministic, stochastic and mean-field annealing of an Hopfield model

7. Pattern Recognition Lab by IIIT HYDERABAD [<http://cse20-iiith.vlabs.ac.in/>]

- Feature Representation
- Mean and Covariance
- Linear Perceptron Learning
- Generation of Random Variables
- Bayesian Classification
- MLE: Learning the classifier from data
- Data Clustering: K-Means, MST-based

8. VLSI Lab by IIIT HYDERABAD [<http://cse14-iiith.vlabs.ac.in/>]

- Schematic Design Of Transistor Level Inverter
- Schematic Design Of Transistor Level NAND & NOR Gate
- Schematic Design Of Transistor Level XOR & XNOR Gate
- Schematic Design Of Pass Transistor Logic & Multiplexer
- Delay Estimation In Chain Of Inverters
- Schematic Design Of D-Latch and D-Flip Flop
- Design Of D-Flip Flop Using Verilog
- Design Of Digital Circuits Using Verilog
- Layout Design

9. Computer Architecture & Organization Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/coa/>]

- Ripple Carry Adder
- Carry-Look-Ahead Adder
- Wallace Tree Adder
- Synthesis of Flip Flops
- Registers and Counters
- Combinational Multipliers
- Booth's Multiplier
- Arithmetic Logic Unit
- Memory Design
- Associative cache Design
- Direct Mapped cache Design
- CPU Design
- Karnaugh Map
- Quine - McClusky Algorithm

10. Software Engineering Lab by IIT KHARAGPUR [<http://vlabs.iitkgp.ernet.in/se/>]

- Identifying the Requirements from Problem Statements
- Estimation of Project Metrics
- Modeling UML Use Case Diagrams and Capturing Use Case Scenarios
- E-R Modeling from the Problem Statements
- Identifying Domain Classes from the Problem Statements
- Statechart and Activity Modeling
- Modeling UML Class Diagrams and Sequence diagrams
- Modeling Data Flow Diagrams
- Estimation of Test Coverage Metrics and Structural Complexity
- Designing Test Suites

11. Data Structures Lab by IIIT HYDERABAD [<http://cse01-iiith.vlabs.ac.in/>]

- a. Number Systems
- b. Expression Evaluation using Stacks
- c. Sorting using Arrays
- d. Polynomials via Linked Lists
- e. Search Trees
- f. Expression Trees
- g. Graph Traversals
- h. Shortest Paths in Graphs
- i. Minimum Spanning Trees

12. Computer Programming Lab by IIIT HYDERABAD [<http://cse02-iiith.vlabs.ac.in/>]

- a. Numerical Approximation,
- b. Functions,
- c. Advanced Control Flow,
- d. Arrays,
- e. Structures,
- f. Basic Control Flow,
- g. Strings,
- h. Pointers,
- i. Recursion,
- j. Expression Evaluation

13. Computer Organization Lab by IIIT HYDERABAD [<http://cse11-iiith.vlabs.ac.in/>]

- a. Representation of Integers and their Arithmetic
- b. Representation of Floating Point Numbers and their Arithmetic
- c. Virtual Memory
- d. MIPS Assembly Language Programming - 1
- e. ARM Assembly Language Programming - 1
- f. ARM Assembly Language Programming - 2
- g. Single Cycle MIPS CPU

14. Speech Signal Processing Lab by IIIT HYDERABAD [<http://ssp-iiith.vlabs.ac.in/>]

- a. Manual speech signal-to-symbol transformation
- b. Speech production mechanism
- c. Nature of speech signal
- d. Basics of DSP
- e. Short-time spectrum analysis of speech
- f. Spectrographic analysis of speech
- g. Cepstral analysis of speech
- h. Linear prediction analysis of speech
- i. Formant synthesis
- j. Analysis-by-synthesis of speech

15. Computer Graphics Lab by IIIT HYDERABAD [<http://cse18-iiith.vlabs.ac.in/>]

- a. Points and Co-ordinate Systems
- b. Transformations: Translation
- c. Transformations: Rotation
- d. Transformations: Scaling
- e. Hierarchical Transformations: 2D Demo
- f. Hierarchical Transformations: 3D Articulated Arm
- g. Projections and Cameras
- h. Clipping: Line
- i. Clipping: Polygon
- j. Rasterization: Line

k. Rasterization: Polygon

16. Image Processing Lab by IIIT HYDERABAD [<http://cse19-iiith.vlabs.ac.in/>]

- a. Distance and Connectivity
- b. Image Arithmetic
- c. Affine Transformation
- d. Point Operations
- e. Neighbourhood Operations
- f. Image Histogram
- g. Fourier Transform
- h. Color Image Processing
- i. Morphological Operations
- j. Image Segmentation
- k. Image Processing Test Bench

17. Computational Linguistics Lab by IIIT HYDERABAD [<http://cl-iiith.vlabs.ac.in/>]

- a. Forming Sentences-1
- b. Forming Sentences-2
- c. Tokens and Types
- d. Heap's Law
- e. Dictionary Generation
- f. Coarse-grained POS Tagging
- g. Fine-grained POS Tagging
- h. Chunking

18. Natural Language Processing Lab by IIIT HYDERABAD [<http://nlp-iiith.vlabs.ac.in/>]

- a. Word Analysis
- b. Word Generation
- c. Morphology
- d. N-Grams
- e. N-Grams Smoothing
- f. POS Tagging: Hidden Markov Model
- g. POS Tagging: Viterbi Decoding
- h. Building POS Tagger
- i. Chunking
- j. Building Chunker

19. Wireless Sensor Network Lab by AMRITA VISHWA VIDYAPEETHAM [<http://vlab.amrita.edu/index.php?sub=78>]

- a. Introduction to WSN
- b. nesC Programming
- c. Send and Receive

- d. Range & Connectivity vs. Antenna Power
- e. Duty Cycle vs. Power Consumption
- f. Sensor Data Acquisition
- g. Data Collection Frequency and Tx. vs. Power Consumption
- h. Wireless Propagation
- i. Wireless Sensor Network
- j. Wireless Sensor Network Data Acquisition, Transmission, and Aggregation
- k. Clustering Algorithms
- l. Time Synchronization

20. Cryptography Lab by IIIT HYDERABAD [<http://cse29-iiith.vlabs.ac.in/>]

- a. Breaking the Shift Cipher
- b. Breaking the Mono-alphabetic Substitution Cipher
- c. One-Time Pad and Perfect Secrecy
- d. Message Authentication Codes
- e. Cryptographic Hash Functions and Applications
- f. Symmetric Key Encryption Standards (DES)
- g. Symmetric Key Encryption Standards (AES)
- h. Diffie-Hellman Key Establishment
- i. Public-Key Cryptosystems (PKCSv1.5)
- j. Digital Signatures

Virtual labs available belonging to the subjects of area of Electronics and Communication

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12. Digital Applications Lab by IIT BOMBAY

[<https://da-iitb.vlabs.ac.in/>]

13. Digital Logic Design by

a) IIT BOMBAY

[<https://dld-iitb.vlabs.ac.in/>]

b) IIIT HYDERABAD

[<http://cse15-iiith.vlabs.ac.in/>]

14. Digital Logic Design using Gates by IIT BOMBAY

[<https://dldg-iitb.vlabs.ac.in/>]

15. Fading Channels and Mobile Communications Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/fcmc/>]

16. Advanced Network Technologies Virtual Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/ant/>]

17. Analog Signals Network and Measurement Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/asnm/>]

18. Digital Electronics Lab by IIT ROORKEE

[<https://de-iitr.vlabs.ac.in/>]

19. Queuing Networks Modelling Lab by IIT DELHI

[<http://qnm-iitd.vlabs.ac.in/>]

20. Hybrid Electronics Lab by COE PUNE
[<http://he-coep.vlabs.ac.in/>]
21. RF and Microwave Characterization Lab by IIT KANPUR
[http://www.iitk.ac.in/mimt_lab/vlab/index.php]
22. Digital Electronic Circuits Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/dec/>]
23. Digital Signal Processing Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/dsp/>]
24. Basic Electronics Lab by IIT KHARAGPUR
[<http://vlabs.iitkgp.ernet.in/be/>]
25. Signals and Systems Lab by IIT GUWAHATI
[<http://ssl-iitg.vlabs.ac.in/>]
26. Electric Circuits Lab by AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php>]
27. Electronics Devices and Circuits Lab by IIT BOMBAY
[<https://ee-iitb.vlabs.ac.in/>]
28. Satellite Modelling and Simulation Lab by IIT BOMBAY
[<https://aero04-iitb.vlabs.ac.in/>]
29. Analog Electronics Lab by IIT ROORKEE
[<https://ae-iitr.vlabs.ac.in/>]
30. Electronic Instrumentation Lab by IIT GUWAHATI
[<https://vem-iitg.vlabs.ac.in/>]
31. Digital VLSI Design Virtual Lab by IIT GUWAHATI
[<https://vlsi-iitg.vlabs.ac.in/>]

Details of experiments under each subject:

1. Digital Applications Lab by IIT BOMBAY [<https://da-iitb.vlabs.ac.in/>]
 - a. Washing machine control using basic AND and NOT gates
 - b. Basics of OR gate and its application in industrial control
 - c. Basics of NOT gate and its application in an eight bit ones complement circuit
 - d. Basic NOT gate and its application in fuel level indicator
 - e. Seat belt warning system using basic AND and NOT gates
 - f. Basics of AND gate and its application in car wiper control
 - g. Water level control using basic AND and NOT gates
 - h. Electronic lock using basic logic gates
 - i. Universal NAND gate and its application in level monitoring in chemical plant
 - j. Universal NOR gate and its application in automobile alarm system
 - k. XOR gate and its application in staircase light control
 - l. Majority circuit using basic logic gates
 - m. Cockpit warning light control using basic logic gates
 - n. DIY Build your own combinational logic circuit using generalized simulator

2. Digital Logic Design by
 - i. IIT BOMBAY [<https://dld-iitb.vlabs.ac.in/>]
 - a. Implementation of 8:1 multiplexer using MSI ICs
 - b. Design of four variable function using MSI ICs
 - c. Design of Gray to Binary code converter using MSI ICs
 - d. Design of Binary to Gray code converter using MSI ICs
 - e. Implementation of binary adder using MSI ICs
 - f. Design of binary subtractor using MSI ICs
 - g. Implementation of four bit digital comparator using MSI ICs
 - h. Design of eight bit digital comparator using MSI ICs

 - ii. IIIT HYDERABAD [<http://cse15-iiith.vlabs.ac.in/>]
 - a. Adder Circuit
 - b. Multiplexer
 - c. Decoder with 7-Segment Display
 - d. ALU with function
 - e. Comparator
 - f. Latch and Flip Flops
 - g. Registers
 - h. Counters
 - i. Multipliers
 - j. State Diagrams

3. Digital Logic Design using Gates by IIT BOMBAY [<https://dldg-iitb.vlabs.ac.in>]

- a. Design of multiplexer circuit using gates
- b. Multiplexer using Universal logic gates
- c. Demultiplexer using basic logic gates
- d. Demultiplexer using Universal logic gates
- e. Application of Multiplexer

4. Fading Channels and Mobile Communications Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/fcmc/>]

- a. Understanding of Pathloss
- b. Pathloss with Shadowing
- c. Horizontal and Vertical Beam Pattern
- d. Calculation of Boundary Coverage Probability
- e. Calculation of SINR including Beam Tilt, A: Downlink B: Uplink
- f. Frequency Reuse A: Co-Channel Cells B: Cell Cluster
- g. Sectoring
- h. Handoff
- i. Flat Fading
- j. Frequency Selective Fading

5. Advanced Network Technologies Virtual Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/ant/>]

- a. Basics of Network Simulation
- b. Simulating a Local Area Network
- c. Measuring Network Performance
- d. Evaluation using NS-2
- e. Simulation of a Satellite Network
- f. Simulating a Wi-Fi Network
- g. Simulating a WiMAX Network
- h. Simulating a Mobile Adhoc Network
- i. Simulating a Wireless Sensor Network
- j. Setting up a Bluetooth Network
- k. Setting up a ZigBee Network

6. Analog Signals Network and Measurement Lab by IIT KHARAGPUR

[<http://vlabs.iitkgp.ernet.in/asnm/>]

- a. Verification of Norton Theorem
- b. Verification of Thevenin Theorem
- c. Verification of Tellegen's Theorem
- d. Verification of Superposition Theorem
- e. Verification of Millman's Theorem
- f. Three Phase Power Measurement
- g. R-L-C Circuit Analysis
- h. Tests on Single Phase Transformer
- i. Verification of Compensation Theorem
- j. Verification of Reciprocity Theorem
- k. Verification of Maximum Power Transfer Theorem
- l. Determination of different parameters of Two-port network and verification of their interrelations

7. Digital Electronics Lab by IIT ROORKEE [<https://de-iitr.vlabs.ac.in/>]

- a. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates
- b. Construction of half and full adder using XOR and NAND gates and verification of its operation
- c. To Study and Verify Half and Full Subtractor
- d. Realization of logic functions with the help of Universal Gates (NAND, NOR)
- e. Construction of a NOR gate latch and verification of its operation
- f. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates
- g. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers
- h. Implementation and verification of decoder or de-multiplexer and encoder using logic gates
- i. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates
- j. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop
- k. Verify Binary to Gray and Gray to Binary conversion using NAND gates only
- l. Verify the truth table of one bit and two bit comparator using logic gates

8. Queuing Networks Modelling Lab by IIT DELHI [<http://qnm-iitd.vlabs.ac.in/>]

- a. Markovian Queues (Three)
- b. Non-Markovian Queues (Four)
- c. Queuing Networks (Four)

9. Hybrid Electronics Lab by COE PUNE [<http://he-coep.vlabs.ac.in/>]

- a. Design and Implementation of Various Arithmetic Circuits
- b. Design and Simulate Various Code Converters
- c. Design and Simulation of Various Counters and Shift Registers
- d. Design and Simulation of Arithmetic Logic Unit
- e. Design and Simulation of Decoders, Encoders, Multiplexer and Demultiplexer
- f. Design and Simulate Analog to Digital Converter and Digital to Analog Converter
- g. Implementation of monostable and astable oscillator using IC 555

10. RF and Microwave Characterization Lab by IIT KANPUR

[http://www.iitk.ac.in/mimt_lab/vlab/index.php]

- a. Study of field pattern of various modes inside a rectangular waveguide.
- b. Study of field pattern of various modes inside a rectangular waveguide cavity.
- c. Measurement of the dielectric constant and loss tangent of materials in microwave frequency band using a rectangular waveguide cavity.
- d. Observe the transient phenomenon of terminated coaxial transmission lines in order to study their time domain behaviour.
- e. Study the behavior of terminated coaxial transmission lines in frequency domain.
- f. Introduction to Smith chart and its application for the unknown impedance measurement.
- g. Study the behavior of impedance matching for passive networks using Smith chart.
- h. Concept of generalized n-port scattering parameters, and formulation of these parameters into 2-port reflection and transmission coefficients.
- i. Find the change in characteristics impedance and reflection coefficients of the transmission line by changing the dielectric properties of materials embedded between two conductors.
- j. Introduce the concept of ratio meter, and its significance for the scalar network analyzer.

11. Digital Electronic Circuits Lab by IIT KHARAGPUR [<http://vlabs.iitkgp.ernet.in/dec/>]

- a. Analysis of Functions of BCD-TO-7-segment Decoder / Driver and Operation of 7-segment LED Display
- b. Characterization of Digital Logic Families
- c. Analysis and Synthesis of Boolean Expressions using Basic Logic Gates
- d. Analysis and Synthesis of Logic Functions using Multiplexers
- e. Analysis and Synthesis of Logic Functions using Decoders
- f. Analysis and Synthesis of Boolean Relations using Digital Comparators

- g. Analysis and Synthesis of Arithmetic Expressions using Adders / Subtractors
- h. Analysis and Synthesis of Sequential Circuits using Basic Flip-Flops
- i. Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers
- j. Design of Arithmetic Logic Unit (ALU)

12. Digital Signal Processing Lab by IIT KHARAGPUR [<http://vlabs.iitkgp.ernet.in/dsp/>]

- a. Study of sampling theorem, effect of undersampling.
- b. Study of Quantization of continuous-amplitude, discrete-time analog signals.
- c. Study of different types of Companding Techniques.
- d. Study of properties of Linear time-invariant system.
- e. Study of convolution: series and parallel system.
- f. Study of Discrete Fourier Transform (DFT) and its inverse.
- g. Study of Transform domain properties and its use.
- h. Study of FIR filter design using window method: Lowpass and Highpass filter.
- i. Study of FIR filter design using window method: Bandpass and Bandstop filter.
- j. Study of Infinite Impulse Response (IIR) filter.

13. Basic Electronics Lab by IIT KHARAGPUR [<http://vlabs.iitkgp.ernet.in/be/>]

- a. Familiarisation with Resistor
- b. Familiarisation with Capacitor
- c. Familiarisation with Inductor
- d. Ohm's Law
- e. VI Characteristics of a Diode
- f. Half Wave Rectification
- g. Full Wave Rectification
- h. Capacitative Rectification
- i. Zener Diode-Voltage Regulator
- j. BJT Common Emitter Characteristics
- k. BJT Common Base Characteristics
- l. Studies on BJT CE Amplifier
- m. RC Frequency Response
- n. RC Differentiator and Integrator
- o. Black Box
- p. Study of basic properties of Operational Amplifier: Inverting and Non-Inverting Amplifiers
- q. Study of Differentiator and Integrator using Operational Amplifier

14. Signals and Systems Lab by IIT GUWAHATI [<http://ssl-iitg.vlabs.ac.in/>]

- a. Signals and their properties: Demonstration of different signals and their properties.

- b. System and their property: Demonstration of Salient properties systems.
- c. Fourier analysis of signals: Analysis of Fourier properties of Signals. There are SIX sub-experiments within this experiment.
- d. Sampling and signal reconstruction: Demonstration of sampling/ reconstruction of signals and spectral analysis using DFT.
- e. Analysis of LTI system response: Convolution and correlation of signals.

15. Electric Circuits Lab by AMRITA VISHWA VIDYAPEETHAM

[<http://vlab.amrita.edu/index.php>]

- a. Parallel RC Circuits
- b. Parallel LC Circuits
- c. Thevenin's Theorem
- d. Series RL Circuits
- e. Norton's theorem
- f. Series LCR Circuits
- g. Kirchhoff's Laws
- h. Series RC Circuits
- i. Series LC Circuits
- j. Parallel LCR Circuits
- k. Parallel RL Circuits

16. Electronics Devices and Circuits Lab by IIT BOMBAY [<https://ee-iitb.vlabs.ac.in/>]

- a. I-V Characteristics and Fabrication of p-n junction Diode
- b. I-V Characteristics of LED Diode
- c. Rectifier Circuits
- d. Wave Shaping Circuits using Diodes
- e. BJT characteristics
- f. BJT biasing and amplifier response
- g. RC circuits
- h. Wien Bridge Oscillator
- i. Non linear circuits using Opamps
- j. Active filters
- k. Monostable and Astablemultivibrators using IC 555

17. Satellite Modelling and Simulation Lab by IIT BOMBAY [<https://aero04-iitb.vlabs.ac.in/>]

- a. Proportional Controller
- b. Reference Frames and Transformations

- c. Heat Transfer
- d. Doppler Shift in Signal Frequency

18. Analog Electronics Lab by IIT ROORKEE [<https://ae-iitr.vlabs.ac.in/>]

- a. Log and antilog amplifiers
- b. Voltage comparator
- c. Wien bridge oscillator using operational amplifier
- d. Voltage regulator using operational amplifier to produce output of 12V with maximum load current of 50mA
- e. Voltage to current converters
- f. Function generator using operational amplifier (sine, triangular & square wave)
- g. Astable and monostable multivibrator using IC 555

19. Electronic Instrumentation Lab by IIT GUWAHATI [<https://vem-iitg.vlabs.ac.in/>]

- a. Magnetic Field Behaviour in single coil: To study the generation of magnetic field in a single coil system due to DC and AC current
- b. Rotating Magnetic Field Behaviour in two coils: To study the behaviour of rotating magnetic field in a two coil system due to AC current
- c. Rotating Magnetic Field Behaviour in three coils: To study the behaviour of rotating magnetic field in a three coil system due to AC current
- d. The DC Test for Stator Resistance: To measure the DC resistance of stator winding of the induction motor
- e. No-Load Test: To determine the equivalent circuit parameters
- f. Blocked-Rotor Test: To determine the equivalent circuit parameters
- g. Stator Resistance Starter: To start the induction motor by connecting external rheostat to the stator winding
- h. Auto Transformer Starting: To start the induction motor using 3-phase auto-transformer
- i. Star-Delta Starting: To start the induction motor by applying Star-Delta starter

20. Digital VLSI Design Virtual Lab by IIT GUWAHATI [<https://vlsi-iitg.vlabs.ac.in/>]

- a. MOSFET: To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel MOSFET.
- b. CMOS Inverter: To design and plot the static (VTC) and dynamic characteristics of a digital CMOS inverter.
- c. Ring Oscillator: To design and plot the output characteristics of a 3-inverter ring oscillator.

- d. Logic Gates: To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.
- e. 4x1 Multiplexer: To design and plot the characteristics of a 4x1 digital multiplexer using pass transistor logic.
- f. Latches: To design and plot the characteristics of a positive and negative latch based on multiplexers.
- g. Registers: To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers.

Virtual labs available belonging to the subjects of area of Biotechnology

By the end of December 2020, there are total 14 subjects' virtual labs are available. These subjects can be found at:

<https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

All of these labs have been developed by prestigious engineering institutes of India. The details of list of experiments under each of these subjects are mentioned from next page.

1. Immunology Lab I and II by Amrita Lab
<http://vlab.amrita.edu/?sub=3&brch=69>
<http://vlab.amrita.edu/?sub=3&brch=70>
2. Molecular Biology Lab I and II by Amrita Lab
<http://mbvi-au.vlabs.ac.in/>
<https://mbvii-au.vlabs.ac.in/>
3. Biochemistry Lab by Amrita Lab
<http://vlab.amrita.edu/?sub=3&brch=63>
4. Bioinformatics virtual Lab I and Lab II By Amrita Lab
<http://vlab.amrita.edu/index.php?sub=3&brch=273>
<http://vlab.amrita.edu/index.php?sub=3&brch=274>
5. Thermodynamics and chemical process lab
<http://vlab.amrita.edu/index.php?sub=2&brch=191&sim=849&cnt=1>
6. Microbiology Lab -I and Lab-II by Amrita Lab
<https://mvi-au.vlabs.ac.in/>
<http://vlab.amrita.edu/?sub=3&brch=76>
7. Comparative and Functional Genomics Lab by Amrita Labs
<https://vlab.amrita.edu/?sub=3&brch=186>
8. Bio-Medical Instrumentation Lab by IIT Roorkee
<https://bmi-iitr.vlabs.ac.in/>
9. Bioprocess and Industrial Biotechnology by Sakshat Virtual Labs, IIT Delhi
<http://209.211.220.205/model/sek/theory.html>
10. Biophysics Lab by Amrita Labs
<http://vlab.amrita.edu/index.php?sub=3&brch=258>
11. Cell biology Lab I and Lab II by Amrita Lab
<http://cbi-au.vlabs.ac.in/> , <http://cbii-au.vlabs.ac.in/>
12. Biotechniques Lab by Amrita Labs
<https://vlab.amrita.edu/?sub=3&brch=277>

<https://vlab.amrita.edu/?sub=3&brch=186>

13. IT Practice Lab by Virtual Labs IIIT Hyderabad

<http://ps->

[iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science](http://ps-iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science)

14. Environmental Engineering Lab by IIT Bombay

<http://vlabs.iitb.ac.in/vlabs->

[dev/labs/nitk_labs/Environmental_Engineering_1/experimentlist.html](http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experimentlist.html)

Details of experiments under each subject:

1. Immunology

(<http://vlab.amrita.edu/?sub=3&brch=69> , <http://vlab.amrita.edu/?sub=3&brch=70>)

- a. Blood grouping experiment
- b. Collection of serum from blood
- c. Isolation of lymphocytes from blood
- d. Latex Agglutination
- e. INDIRECT Elisa
- f. DIRECT Elisa
- g. SANDWICH Elisa
- h. ELISPOT Assay
- i. Ouchterlony Double Diffusion -Titration
- j. Ouchterlony Double Diffusion - Patterns
- k. Antibody Labeling with HRP
- l. Purification of IgG Antibodies with Ammonium Sulphate
- m. Mouse anesthesia and blood collection
- n. Removal of thymus and spleen from mice
- o. Extraction of IgG Antibodies from Immunized Hen Egg
- p. Isolation of lymphocytes from whole blood
- q. Parenteral Injections
- r. Purification of IgG Antibodies using Affinity Chromatography
- s. Fluorescent Labeling of Antibodies
- t. Fragmentation of IgG Using Papain
- u. Fragmentation of IgG using pepsin

2. Molecular Biology

(<http://mbvi-au.vlabs.ac.in/> , <https://mbvii-au.vlabs.ac.in/>)

- a. Electroblothing
- b. Extraction of Bacteriophage DNA from Large Scale Cultures Using Proteinase K and SDS
- c. Ligation (Using T4 DNA Ligase)
- d. Plasmid Curing
- e. Plating of the Bacteriophage
- f. Polyacrylamide Gel Electrophoresis
- g. Polymerase Chain Reaction (PCR)
- h. Preparation of Stocks of Bacteriophage Lambda by Plate Lysis and Elution
- i. Agarose Gel Electrophoresis (AGE)
- j. Restriction Digestion
- k. Transformation of the Host Cells
- l. Extraction of DNA from Agarose gel

- m. Maintenance and Storage of DH5alpha E.coli cells
- n. Extraction of DNA from Fish Fins
- o. Plasmid Isolation (Mini prep)
- p. Preparation of Competent Cell (Calcium Chloride Treatment)

3. Biochemistry Virtual Lab by Amrita Lab

<http://vlab.amrita.edu/?sub=3&brch=63>

- a. Qualitative and quantitative estimation of carbohydrates
- b. Qualitative estimation of proteins
- c. Qualitative estimation of amino acids
- d. Separation of Amino Acids by Thin Layer Chromatography
- e. Estimation of Saponification Value of Fats/Oils
- f. Detection of Adulteration in Milk
- g. Quantitative Estimation of Amino Acids by Ninhydrin
- h. Isoelectric Precipitation of Proteins: Casein from Milk
- i. Estimation of Iodine Value of Fats and Oils
- j. Titration Curves of Aminoacids
- k. Estimation of blood glucose by Glucose oxidase method

4. Bioinformatics virtual Lab I and Lab II by Amrita Lab

<http://vlab.amrita.edu/index.php?sub=3&brch=273>,

<http://vlab.amrita.edu/index.php?sub=3&brch=274>)

- a. Retrieving sequence data from Entrez
- b. Locating the chromosome of a Gene
- c. Retrieve gene expression data from GEO
- d. Retrieving articles using PubMed
- e. Finding ORF of a Given Sequence
- f. Retrieving structural data of a protein using PDB database
- g. Retrieving Motif Information of a Protein Using Prosite
- h. Retrieving Gene Information from TAIR database
- i. Designing a primer
- j. Global alignment of two sequences - Needleman-Wunsch Algorithm
- k. Smith-Waterman Algorithm - Local Alignment of Sequences
- l. Pairwise Sequence Alignment using BLAST
- m. Pairwise sequence alignment using FASTA
- n. Aligning Multiple Sequences with CLUSTAL W
- o. Construction of Cladogram
- p. Constructing a cladogram using PHYLIP

- q. Phylogenetic Analysis using PHYLIP - Rooted trees
- r. Phylogenetic Analysis using PHYLIP - Unrooted trees

5. Thermodynamics and chemical process lab

<http://vlab.amrita.edu/index.php?sub=2&brch=191&sim=849&cnt=1>

- a. Preparation of sol and gel
- b. The study of phase change
- c. Preparation of aspirin

6. Microbiology Lab -I and Lab-II by Amrita Lab

(<https://mvi-au.vlabs.ac.in/>, <http://vlab.amrita.edu/?sub=3&brch=76>)

- a. Bacterial Growth Curve
- b. Catalase and Coagulase Test
- c. Differential and Cytological Staining Techniques
- d. Streak Plate Method
- e. Lecithinase Test
- f. Motility Test
- g. Antibiotic Susceptibility Testing
- h. Voges-Proskauer Test
- i. Triple Sugar Iron Agar
- j. Urease Test
- k. Litmus Milk Test
- l. Slide Culture Technique for Fungi
- m. Bacteriophage Plaque Assay for Phage Titer
- n. Isolation and Identification of Auxotrophic and Drug Resistant Mutants
- o. Isolation and Identification of Two Bacterial Unknowns
- p. Routes of Viral Inoculation in Embryonated Eggs
- q. 16S Ribosomal RNA Sequencing

7. Comparative and Functional Genomics Lab

(<https://vlab.amrita.edu/?sub=3&brch=186>)

- a. Preparation of Equilibrated Phenol
- b. Isolation of RNA
- c. Polyacrylamide Gel Electrophoresis
- d. Ligation (Using T4 DNA Ligase)
- e. Polymerase Chain Reaction (PCR)

- f. Electroblothing
- g. Plating of the Bacteriophage
- h. Plasmid Curing
- i. Extraction of Bacteriophage DNA from Large Scale Cultures Using Proteinase K and SDS
- j. Preparation of stocks of bacteriophage lambda by plate lysis and elution

8. Bio-Medical Instrumentation Lab by IIT Roorkee

<https://bmi-iitr.vlabs.ac.in/>

- a. ECG signal acquisition under incorrect electrode placement
- b. ECG Feature extraction and analysis
- c. ECG Acquisition and HRV (Heart Rate variability) analysis in time and frequency domain
- d. EEG Acquisition and Frequency components calculation
- e. EEG PSD Calculation
- f. EEG Approximate entropy calculation
- g. EEG Alpha RMS derivation
- h. Electromyography(EMG) Toolbox

9. Bioprocess and Industrial Biotechnology by Sakshat Virtual Labs, IIT Delhi

<http://209.211.220.205/model/sek/theory.html>)

- a. Bioreactor- Basics
- b. Control Characteristics of pH Controller
- c. Estimation of growth kinetic parameters in batch fermentation
- d. Simultaneous measurement of specific growth / death rate of micro organisms
- e. Determination of Volumetric Mass Transfer Co-efficient (Dynamic method)
- f. Determination of Volumetric Mass Transfer Co-efficient (Oxygen balance method)
- g. Development of mathematical model
- h. Batch Microbial Cultivation
- i. Fed-Batch Microbial Cultivation
- j. Continuous Microbial Cultivation
- k. Biopolymer Production by Microbes
- l. Acetone-Butanol-Ethanol Fermentation
- m. Propionic Acid Fermentation
- n. 1, 3 Propanediol Fermentation
- o. Plant Cell Laboratory Experiment
- p. Plant Cell-Batch Cultivation
- q. Animal Cell Batch Culture
- r. Animal Cell Fed Batch Cultivation
- s. Study of Enzyme Kinetics

- t. Immobilization of whole cells
- u. 15 Liter Bio-reactor Cultivation

10. Biophysics Lab by Amrita Labs

(<http://vlab.amrita.edu/index.php?sub=3&brch=258>)

- a. Using a light microscope (Remote Trigger)
- b. Observing an animal cell using a light microscope (Remote Trigger)
- c. Study of RC Properties of Cell Membrane (Remote Trigger)
- d. Study of Electrically excitable cells (Remote trigger)
- e. Bursting phenomenon in biology via RC models (Remote Trigger)
- f. Micrometry (Remote Trigger)
- g. Multicompartmentalmodelling of biophysical behavior of neurons (Remote Trigger)
- h. Understanding Photosynthesis as a Biologically Closed Process

11. Cell biology Lab I and Lab II by Amrita Lab

(<http://cbi-au.vlabs.ac.in/> , <http://cbii-au.vlabs.ac.in/>)

- a. Isolation of Chloroplast
- b. Light Microscope
- c. Cell Organization and Sub Cellular Structure Studies
- d. Isolation of Mitochondria
- e. Transfection
- f. Basics of Plant Tissue Culture
- g. Glucose Uptake Assay
- h. Isolation of Endoplasmic Reticulum
- i. Mitosis in Onion Root Tips
- j. Hemocytometer (Counting of Cells)
- k. Actin Assembly
- l. Cell Attachment
- m. Cell Migration
- n. Cell Proliferation
- o. Lignin Staining
- p. Maintenance of Mammalian Cell Lines

12. Biotechniques Lab by Amrita Labs

(<https://vlab.amrita.edu/?sub=3&brch=277>,
<https://vlab.amrita.edu/?sub=3&brch=186>)

- a. Drug-Receptor Interaction
- b. Toxicity prediction of a Molecule
- c. Polymerase Chain Reaction (PCR)
- d. To maintenance and resuscitate of Mammalian Cell Lines

- e. Determination of cell viability in Mammalian cell lines
- f. Preparation and Instrumentation of Chromatography

13. IT Practice Lab by Virtual Labs IIT Hyderabad

[http://ps-](http://ps-iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science)

[iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science](http://ps-iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science)

- a. To understand scalars, arrays and hashes in Perl and study its applications
- b. To make use of regular expressions of Perl in biological problems

14. Environmental Engineering Lab by IIT Bombay

[http://vlabs.iitb.ac.in/vlabs-](http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experimentlist.html)

[dev/labs/nitk_labs/Environmental_Engineering_1/experimentlist.html](http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experimentlist.html)

- a. Determination of Biological Oxygen Demand
- b. Determination of TS, TDS and TSS in Water
- c. Determination of Alkalinity in Water
- d. Determination of Hardness in Water
- e. Determination of Chloride in Water
- f. Determination of Total Iron in Water
- g. Determination of pH

Virtual labs available belonging to the subjects of area of Physical Sciences

By the end of December 2020, there are total 10 subjects virtual labs are available. These subjects can be found at:

<https://www.vlab.co.in/broad-area-physical-sciences>

All of these labs have been developed by prestigious engineering institutes of India. The details of list of experiments under each of these subjects are mentioned from next page.

1. Electricity and Magnetism Virtual Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=192>]
2. Optics Virtual Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=281>]
3. Molecular Interactions Lab IIIT HYDERABAD
[<http://mi-iiith.vlabs.ac.in/>]
4. Solid State Physics Virtual Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/?sub=1&brch=282>]
5. Mechanics Virtual Lab (Pilot) AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=74>]
6. Advanced Mechanics Virtual Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=280>]
7. Laser Optics Virtual Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=189>]
8. Heat & Thermodynamics Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=194>]
9. Modern Physics Lab AMRITA VISHWA VIDYAPEETHAM
[<http://vlab.amrita.edu/index.php?sub=1&brch=195>]
10. Harmonic Motion and Waves Lab AMRITA VISHWA VIDYAPEETHAM

[<http://vlab.amrita.edu/index.php?sub=1&brch=201>]

Details of experiments under each subject:

1. Electricity and Magnetism Virtual Lab AMRITA VISHWA
VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=192>]

- a) Tangent Galvanometer
- b) Magnetic Field Along The Axis of A Circular Coil Carrying Current
- c) Deflection Magnetometer
- d) Van De Graaff Generator
- e) Barkhausen Effect
- f) Temperature Coefficient of Resistance
- g) Anderson's Bridge
- h) Quincke's Method

2. Optics Virtual Lab AMRITA VISHWA
VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=281>]

- a) Resolving power of a prism
- b) Angle of the prism using Spectrometer
- c) Spectrometer i-i' curve
- d) Spectrometer: i-d curve
- e) Spectrometer- Determination of Cauchy's constants
- f) Spectrometer, Refractive Index of the material of a prism
- g) Spectrometer, Dispersive power of a prism
- h) Diffraction Grating

3. Molecular Interactions Lab IIIT HYDERABAD[<http://mi-iiith.vlabs.ac.in/>]

- a) Internuclear forces in a diatomic molecule: Optical and magnetic tweezer experiments
- b) Molecular forces in a triatomic molecule: A magnetic tweezer experiment
- c) Dihedral forces in a quad-atomic molecule: A magnetic tweezer experiment
- d) Interatomic van der Waals forces
- e) van der Waals forces between molecules
- f) Interatomic electrostatic forces
- g) Electrostatic forces between molecules
- h) Many-body forces in a polyatomic molecule
- i) Solvent viscous forces on a polyatomic molecule

- j) Molecular separation using interatomic forces: Column chromatography
 k) Radiation forces on a dielectric particle
4. Solid State Physics Virtual Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/?sub=1&brch=282>]
- Characteristics of Zener diode
 - Characteristics of Thermistor
 - Resistivity by Four Probe Method
 - B-H Curve
 - Hall effect experiment:- Determination of charge carrier density
 - Cornus Experiment
 - Zener Diode as Voltage Regulator
 - Crystal Structure
5. Mechanics Virtual Lab (Pilot) AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=74>]
- Torque and angular acceleration of a fly wheel
 - Torsional oscillations in different liquids
 - Moment of Inertia of Flywheel
 - Newton's Second Law of Motion
 - Ballistic Pendulum
 - Collision balls
 - Projectile Motion
 - Elastic and Inelastic Collision
6. Advanced Mechanics Virtual Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=280>]
- Rigidity Modulus of The Suspension Wire of A Torsion Pendulum
 - Young's Modulus-NonUniform Bending
 - Compound Pendulum- Symmetric
 - Kater's pendulum
 - Young's Modulus-Uniform Bending
 - Moment of inertia of a Torsion Pendulum
 - Rigidity Modulus -Static Torsion
7. Laser Optics Virtual Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=189>]

- a) Michelson's Interferometer- Refractive index of glass plate
- b) Newton's Rings-Refractive index of liquid
- c) Michelson's Interferometer- Wavelength of laser beam
- d) Laser beam divergence and spot size
- e) Newton's Rings-Wavelength of light
- f) Brewsters Angle determination
- g) Numerical Aperture of Optical Fiber

8. Heat & Thermodynamics Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=194>]

- a) Heat Transfer by Radiation
- b) Heat transfer by Conduction
- c) Heat Transfer by Natural Convection
- d) The Study of Phase Change
- e) Black Body Radiation: Determination of Stefan's Constant
- f) Newton's Law of Cooling
- g) Lee's Disc Apparatus
- h) Thermo Couple-Seebeck Effect

9. Modern Physics Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=195>]

- a) Franck-Hertz Experiment
- b) Soldering (Remote Trigger)
- c) Solar Panel Experiment (Remote Trigger)
- d) Photoelectric effect
- e) Determination of Planck's Constant
- f) Abbe's Refractometer
- g) Emission spectra
- h) Millikan's oil drop experiment
- i) Magnetic Material Characterization via Hysteresis (Remote Trigger)

10. Harmonic Motion and Waves Lab AMRITA VISHWA
 VIDYAPEETHAM[<http://vlab.amrita.edu/index.php?sub=1&brch=201>]

- a) Astablemultivibrator
- b) Melde's String Apparatus
- c) Kundt's Tube Apparatus
- d) Ultrasonic Interferometer
- e) Doppler Effect
- f) A.C Sonometer
- g) Colpitts Oscillator
- h) Hartley Oscillator