List of Laboratories for Undergraduate Students

Humanities and Social Sciences Lab	
Title	English Language Lab
	The Laboratory Course for English Language and Literature is primarily meant to augment the language aspect of the course. The multi-media computer facility will be extensively used for the tutorial/lab sessions. The 8 th edition of the Oxford Advanced Learner's Dictionary (with CD) will be extensively used along with the internet resources. All the students are expected to have access to the dictionary and they should learn to use it extensively. The CD of the OALD contains a section titled "Resources" consisting of Dictionary Skills and Grammar. From the Grammar section, the following topics will be focused upon: articles, regular verbs, tenses and their use, active and passive voice, modal verbs, and reported speech. From the Dictionary Skills section, the following topics will be focused upon: nouns, irregular verbs, adjectives and adverbs, grammatical patterns, the idioms, phrasal verbs and register (formal and informal, technical, slang). The pronunciation aspect will be handled by listening to the pronunciation of words which can be heard from the CD and also by learning the phonetic symbols used for the basic sounds. All these will be further practiced with the use of interactive internet material from the links mentioned below.
Title	English Language and Communication
	-Writing, Reading, Comprehension skills in English - Paragraph Development -Grammar and mechanics
Chemistry Lab	
Title	Chemistry Lab
	Experiments illustrating the concepts of (1) galvanic cells, (2) Thermochemistry, (3) chemical kinetics, (4) equilibrium constant, (5) analysis by oxidation reduction titration.
Physics Lab	
Title	Physics Lab

	Determination of gravitational constant (g) Effect of magnetic field on materials (Hall Effect and Universal BH Curve Tracer) Frank Hertz Experiment. LCR Circuit, and Thermal & Electric Conductivity Kundt's Tube Fresnel's Bi-prism Grating Spectrometer Hydrogen Spectrum Specific Charge of Electron (e/m) Newton's Rings
Computer Science and Engineering Lab	
Title	Computer Programming Laboratory
	Students would be made to work through programming assignments on the following topics in C++: 1) Data types 2) Control Statements 3) Functions 4) Pointers and Arrays 5) Dynamic Memory Allocation 6) Classes and Objects 7) Constructors and Destructors 8) Operator Overloading 9) Inheritance 10) Virtual Functions 11) File Handling and I/O Operations
Title	Data Structures and Algorithms Lab
	Experiments and assignments based on creating and manipulating various data structures.
Title	Design and Analysis of Algorithms Laboratory
	* Runtime analysis of different sorting algorithms and linked lists in best-case, worst-case, and average-case. * Implementation and analysis of algorithms based upon following design techniques: a) Divide and Conquer Strategy (Closest Pair of Points, Integer Multiplication, Matrix Multiplication, Fast Fourier Transform etc.). b) Greedy Strategy (Interval Partitioning, Dijkstra's Algorithm, Minimum Spanning Tree etc.). c) Dynamic Programming Strategy (Weighted Interval Scheduling, Sequence Alignment, Bellman-Ford Algorithm etc.). * Implementation of algorithms related to Network Flows (Max-

	Flow, Min-Cut, Ford-Fulkerson Algorithm etc.). * Implementation of algorithms for different Problem Classes (Intractability).
Title	Abstractions and Paradigms for Programming Lab
	1. Functional Programming Basics using Scheme: Expressions, Naming, Combinations, Procedures, Conditions. 2. Recursion: Procedure v/s Process; Recursive v/s Iterative 3. Scheme: Higher-Order procedures, let, lambda; Procedures as Arguments, General Methods. 4. Lists: Basic Operations using Lists in Scheme 5. Matrix Manipulation in Scheme 6. Tags & Multiple Representations in Scheme 7. Object-Oriented Programming: Classes, Objects using Java 8. Inheritance, Polymorphism, Message Passing in Java 9. Concurrent Programming: Creating Thread, Use Different Functions Related Thread in Java 10. Thread Synchronization & Producer Consumer Problems in Java 11. Logic Programming using Prolog: Domain Variables, Specification of Constraints, Solution Space. 12. Imperative Programs, Loop Invariants.
Title	Logic Design Lab
	Experiments with Logic Building Blocks using SSI/MSI, Experiments on Design and/or use Minimization tools. Use of VHDL and simulation in Logic Design. A small project on design with the use of tools and MSI and/or PLDs. FPGA basics and programming.
Title	Software Engineering Laboratory
	Students would be made to go through and experience the various phases of the Software Development Life Cycle by working on a real project and sequentially working through the phases. The Software Developments Phases include broadly: 1) Requirements Elicitation 2) Software Design 3) Software Development 4) Software Testing 5) Software Maintenance
Title	Database and Information Systems Lab
	Use of database systems supporting interactive SQL. Two-tier client-server applications using JDBC or ODBC. Three-tier web applications using Java servlets/JDBC or equivalent.

	Design of applications and user interfaces using these systems. Data analysis tools. Laboratory project.
Title	Computer Graphics and Visualization Lab
	Assignments based on of applications of computer graphics and visualizations in the fields such as 3D-modeling of architectural and mechanical design; Creating 3D games; Creating 3D models from segmented volume data; Financial data visualization.
Title	Operating Systems Lab
	OS Programming prerequisites: Familiarities with IPC facilities, IPC identifiers, IPC keys, Message queues and their internal and user data structures, System calls related to IPC, Semaphore and Shared memory. (06 hours ≈2 labs). CPU scheduling: Simulation programs for long-term, short-term and medium term schedulers, Simulation for the maintenance of various scheduling queues such as ready, I/O, blocked etc., Implementations of different scheduling algorithms such as FCFS, SJF, Priority scheduling (pre-emptive and Non preemptive), Round robin, multilevel feedback queue scheduling and their performance evaluations. (12 hours ≈4 labs). Concurrent Processing and Concurrency Control: Simulation of updating four processes PCBs with shared memory, Implementation of interprocess communication using simulated semaphore through i) shared memory, ii) synchronized producer-consumer problem iii) pipes and message passing (asynchronous and synchronous). Concurrence control with pipes socket for iterative and concurrent servers (12 hours ≈4 labs). File Systems Implementation: creating, removing, accessing and protection and error handling of EXT2 FS, Registering the virtual file system in Kernel, accessing superblock information. (06 hours ≈2 labs)
Title	Computational Intelligence Lab
	AI programming : Prolog, LISP, Experiments to support the associated theory course that demonstrate the different applications of Neural, fuzzy, evolutionary and hybrid model; Minor project based on real life applications such as Functional approximation; Time-series prediction; Pattern recognition; Data

	compression; Control applications, Optimization etc.
Title	Computer Architecture Lab
	MIPS Programming through SIMPS: Familiarities with architecture of RISC Computer R2000/R3000 proposed in MIPS Systems. MIPS Assembly language programming for instruction formats, addressing mechanism, microprogramming to transfer data between register-register, memory-register and architectural programming. (12 hours ≈4 labs) Architecture-Level Design with Verilog: Familiarize architecture-level design and synthesis of different components in arithmetic and logic unit. Verilog programming to design basic computing units such as adder, multiplier, BCD converter, Comparator etc. Experiment for datapath synthesis, connecting memory, buffer, external ports and different components in an application specific processing unit. (12 hours ≈4 labs) Synthesis of a CPU Architecture: Familiarize the design aspects of a CPU to realize the design in a FPGA kit. Designing a CPU with a selected specification at architectural-level using Verilog, and finally, realizing the architecture in a FPGA kit followed by testing the correctness of the realization. (12 hours ≈4 labs)
Title	Computer Networks Lab
	(a) Experimental study of application protocols such as HTTP, FTP, SMTP, using network packet sniffers and analyzers such as Wireshark. (b) Socket programming - Small exercises in socket programming in C/C++/Java. (c) Experiments with packet sniffers to study the TCP protocol. 3-way handshake for connection setup, timer behavior, congestion control behavior. (d) Introduction to ns3 (network simulator) and small simulation exercises to study TCP behavior under different scenarios. (e) Setting up a small IP network in ns3 - configure interfaces, IP addresses and routing protocols to set up a small IP network. Study dynamic behavior using packet sniffers. (f) Experiments with ns3 to study behavior (especially performance of link layer protocols such as Ethernet and 802.11 wireless LAN. (g) Programming with pcap - small example with packet generator using pacp library.
Title	Optimization Algorithms and Techniques Lab
	* Understanding of Matlab/ Scilab via implementation of Newton's

	method for solving non-linear system of equations as well as numerical integration. * Analyzing convexity of functions numerically. * Implementation and analysis of Multi-dimensional Unconstrained Optimization algorithms (Steepest Descent, Newton, Gauss-Newton, Quasi-Newton, Conjugate Gradients etc.). * Implementation and analysis of One-dimensional Unconstrained Optimization algorithms (Dichotomous, Quadratic Interpolation, Cubic Interpolation etc.). * Implementation and analysis of Simplex and Interior Point Methods for Linear Program. * Implementation and analysis of Sequential Quadratic Program for solving general Constrained Optimization problem.
Title	Compiler Techniques Lab
	Design and implementation of a compiler for a sufficiently rich subset of a real programming language. The compiler will be automatically generated through use of tools such as LEX, YACC and IBURG.
Title	Soft Computing Lab
	Experiments to support the associated theory course that demonstrate the different applications of soft computing to Optimization; Functional approximation; Time-series prediction; Pattern recognition; Data compression; Control applications.
Electrical Engineering Lab	
Title	Basic Electrical and Electronics Engineering Lab
	1. Familiarization with CRO and function generator 2. Characteristics of passive circuit elements (R,L,C) 3. Verification of network theorems 4. Time and frequency responses of RC, RLC circuits 5. Electronic components and their characteristics: Diode, Zener Diode, Led, Photodetector, Microphone 6. Half-wave rectifier and full-wave rectifier (with and without capacitive filter), Zener regulator and IC regulator. 7. Bipolar Junction Transistor (BJT) circuits to obtain some small signal parameters of BJT. 8. Voltage amplifiers using operational amplifiers to measure and analyze bias quantities (dc currents and voltages) and small-signal gain of the given common-emitter amplifier circuit. 9. Wave shaping and waveform generation using op amps 10. Basic combinatorial circuits 11. Logic design using multiplexers and basic sequential circuits 12. Synchronous and ripple counters

Title	Electronic Devices Lab
	1. Simple Measurements with the Oscilloscope. 2. To measure the DC I-V Characteristics of diodes. 3. Analysis of diode circuits (Clipping Circuits, Voltage Doublers, Rectified Differentiator, Precision Rectifier). 4. To measure the reverse-bias capacitance of p-n junction capacitance 5. To measure the minority carrier lifetime in a semiconductor photodiode. 6. To obtain the I-V characteristics of bipolar transistors and computer transistor parameters. 7. To obtain some small signal parameters of Bipolar Junction Transistors (BJTs). 8. To measure and analyze bias quantities (DC currents and voltages) and small-signal gain of the given common-emitter amplifier circuit. 9. To obtain MOSFET parameters from DC current-voltage measurements.
Title	Analog Circuits Lab
	1) To study the working of inverting, non-inverting, differentiator and integrator circuits using operational amplifier circuits. 2) To study of some measure some of the non-ideal parameters of LM741 including its frequency response. 3) To study two stage RC coupled Amplifier and study its gain bandwidth. 4) To study difference and instrumentation amplifiers. 5) Realization of Trans-conductance and Trans-impedance Amplifiers. 6) Design Challenge -1 (Differential equation solver) (simulation). 7) To study the Half/Full wave Precision rectifier, and log and antilog amplifier circuits. 8) To study the working of active Filter circuits. 9) To study working of Wien Bridge and Phase shift oscillator circuits. 10) To study the working of Schmidt trigger and multi-vibrator circuits. 11) To study Astable and Monostable Multivibrator circuit using IC 555 timer. 12) Design Challenge- 2 (Over/ under voltage warning) (simulation). 13) To study the voltage regulator circuits (simulation). 14) To study ADCs and DACs
Title	Electrical Machines Lab
	1. Parallel Operation of Two Single Phase Transformers **Objectives:**

	1) To determine and verify the polarity of the individual single-phase transformers. 2) To find the impedance of the single phase transformers by short circuit test. 3) To study parallel operation of (the above) two single phase transformers and observe the load sharing between them **2. Determination of the characteristic of a DC Shunt Generator Objectives:** 1) To plot the open circuit characteristics (O.C.C) of a DC shunt generator and to determine its critical resistance. 139 2) To find the residual magnetism in field. 3) To plot the external characteristics of a DC shunt generator by loading the generator. **3. "V" and "inverse V" curves of synchronous motor at no load and constant load. Objectives:** 1) To plot the characteristics of a synchronous machine in terms of variation of armature current with field current when the load and input voltage to the machine is constant. **4. Synchronization of alternators: Using synchroscope. Objectives:** 1) To Study synchronization method of alternator with grid **Power Electronics Experiments** **1. Study of 1-phase AC to DC controlled converter (both fully controlled and half controlled). Objectives:** 1) To study voltage and current waveforms for different firing angles and loads for half controlled and fully controlled rectifier for R and R-L Loads. **2. Study of 3- PHASE Fully Controlled Rectifier. Objectives:** 1) To observe various waveforms with R and R-L loads for fully controlled converters. 2) To plot graphs of mean load voltage against firing delay angles for R and R-L loads. 3) To study variation of power factor against delay angle. **3. To study the switching characteristics of MOSFET and IGBT. Objectives:** 1) Observe the ON and OFF transition waveforms for MOSFET and IGBT. 2) Estimate ON and OFF switching time components for MOSFET and IGBT. **4. Study of various PWM Techniques for Single and Three Phase Inverter with R-L Load. Objectives:** 1) Study of output voltage and current waveforms for different PWM techniques for single phase inverter for R-L load

	2) Study of output voltage and current waveforms for different PWM techniques for three phase inverter for R-L load. 3) Extracting harmonic spectrum information 4) for various PWM Techniques. **5. Mini Project Objectives:** In mini project, the emphasis will be on to design and develop a power 140 electronic circuit for given specifications. In this way, student will be familiar with various aspects of power electronic circuit design like PCB design, magnetics design, component selection etc.
Title	Digital Systems Lab
	1. Introduction to Logic Circuits: To gain familiarity with digital integrated circuits by setting up simple logic circuits. 2. Combinational Logic Circuits: Use of TTL adder, multiplexer and decoder. 3. Sequential Circuits: To try out some elementary sequential circuits. 4. Counters and Shift Registers: To use the 7490 decade counter and 7495 shift register. 5. Timer Circuits and DAC: To learn about (a) open-collector TTL, (b) 555 timer circuits, (C) Digital to Analog Converter. 6. CMOS Logic Gates: (i) Observe and plot transfer characteristic of a CMOS inverter, (ii) Measure noise margin and propagation delay of a CMOS inverter. (iii) Test simple CMOS logic gate circuits.
Title	Microprocessors Lab
	1. Familiarization with the 8085 kit 2. (SW1) Software - 1 3. (SW2) Software - 2 4. (SW3) Software - 3 5.(HW1) Interfacing of 8255 in Mode 0 6. (HW2) Interfacing of 8255 in Mode 1 7.(HW3) Interfacing of ADC and DAC with 8085 8 . (HW4) Study of Interrupts and interfacing of 8253 Time 9. (HW5) Interfacing of USART 8251 10. (HW6) Introduction to Microcontroller
Title	Microprocessors and Digital Systems Design Lab
	1) Familiarization with the 8085 kit 2) (SW1) Software -1 3) (SW2) Software - 2 4) (SW3) Software - 3 5) (HW1) Interfacing of 8255 in Mode 0 6) (HW2) Interfacing of 8255 in Mode 1 7) (HW3) Interfacing of ADC and DAC with 8085

	8) (HW4) Study of Interrupts and interfacing of 8253 Timer 9) (HW5) Interfacing of USART 8251 (HW6) Introduction to Microcontroller Since there are several advancements in the microcontroller domain over the years, several experiments using the ARM family of microcontrollers should be introduced. One such example, would be to use FREEDOM board from NXP to utilize different sensors and introduce real-time programming to the students. The third phase of the lab would involve utilizing FPGAs for programming. One last experiment would be to introduce the concept of System on Programmable Chip (SoPC). **Hardware requirements:** Requirement of microcontroller boards and corresponding programmers (ISPs). These can be procured from Microchip, Arduino and any of the ARM vendors (e.g., NXP). and some SOPC academic boards from Xilinx.
Title	Control Systems Lab
	1. Control System Design for Speed control application using Root Locus Method **Objectives:** 1) Develop a physics-based model for a DC motor 2) For the DC motor, develop a model based on system identification using open-loop step response. 3) Design a speed controller for the physics-based model using Root locus method. 4) Simulate this controller 5) Re-design the controller for the identified model, simulate this controller and implement it practically. **2. Control System Design for Speed control application using Bode Plot** **Objectives:** 1) Develop a physics-based model for a DC motor 2) For the DC motor, develop a model based on system identification using open-loop step response. 3) Design a speed controller for the physics-based model using Bode plot method. 4) Simulate this controller 5) Re-design the controller for the identified model, simulate this controller and implement it practically. **3. Control of speed using armature current** **Objectives:** 1) To control the speed of the pmdc motor using feedback of current

	2) Back emf speed control 3) Speed control using armature current **4. Mini-project involving temperature sensor** **Objectives:** This would be a good team project involving projects like temperature control. The physical model would be developed and a suitable controller would be designed in theory and then experimented practically. All the principles learnt in the course would be used to implement this project
Title	Communications Lab
	Communication Lab I (Analog Communication Lab) **EXPERIMENT NO: 1** **NAME** Amplitude Modulation (AM) Transmitter **AIM** To study AM modulator and its variants. **DESCRIPTION** A. To study the operation of a DSB AM modulator B. To calculate the modulation index of an AM modulated wave C. To study the operation of a DSB-suppressed carrier AM modulator D. To study the operation of an SSB-suppressed carrier AM modulator ***Generate the above waveforms using SDR.*** **EXPERIMENT NO: 2** **NAME** Amplitude Demodulation Receiver **AIM** To study of double sideband (DSB) AM reception. **DESCRIPTION** A. To study DSB AM reception using envelope detector via cable B. To study DSB AM reception using envelope detector via antenna C. To study SSB AM reception using product detector ***Study B using SDR - BOARD and RTL-SDR. Study the impact of changing various parameters*** **EXPERIMENT NO: 3** **NAME** Frequency Modulation (FM) Transmitter **AIM** Study of FM. **DESCRIPTION** A. To plot the modulation characteristic of varactor modulator B. To calculate the modulation sensitivity of varactor modulator C. To observe and measure frequency deviation and modulation

	index of FM D. To study frequency modulation using reactance modulator and measure the frequency deviation ***Generate the above waveforms using SDR – Board*** **EXPERIMENT NO: 4** **NAME** Frequency Demodulation Receiver **AIM** Study of frequency demodulation. 154 **DESCRIPTION** A. To plot the demodulation characteristic of the FM demodulator (FosterSeeley demodulator) B. To study the ratio detector C. To study the phase locked loop (PLL) detector ***Study and create demodulator circuits using SDR - Board and RTL-SDR.*** **EXPERIMENT NO: 5** **NAME** FM amateur radio One-way using SDR **AIM** Real time transfer of FM modulated voice **DESCRIPTION** A. To transmit FM uncompressed voice using GNU-Radio and SDR-Board B. Transmit on ISM band. C. Create a receiver to demodulate the FM and playback the voice at the receiver in real-time. **EXPERIMENT NO: 6** **NAME** Noise spectral density measurement **AIM** Effect of noise on various analog systems. **DESCRIPTION** A. To examine the operation of a noise generator B. To measure the signal-to-noise ratio C. To measure the noise power and noise power spectral density D. To examine the operation of a signal attenuation network **EXPERIMENT NO: 7** **NAME** Pulse Amplitude Modulation (PAM) and Demodulation **AIM** To set up a PAM modulator and demodulator circuits and to observe the waveforms. **DESCRIPTION** After completing this experiment, students will be able to set up PAM modulator and demodulator circuits and identify the

	waveforms. ***Implement and study the same using SDR – Board.*** **EXPERIMENT NO: 8** **NAME** Pulse Width Modulation (PWM) and Demodulation **AIM** To set up a PWM modulator and demodulator circuits and to observe and plot the waveforms. **DESCRIPTION** After completing this experiment, the students will be able to set up PWM modulator and demodulator circuits and to identify PWM waveform. ***Implement and study the same using SDR – Board*** **EXPERIMENT NO: 9** **NAME** 155 Pulse Position Modulation (PPM) and Demodulation **AIM** To set up a PPM modulator and demodulator circuits and to observe and plot the waveforms. **DESCRIPTION** After completing this experiment, the students will be able to set up PPM modulator circuit using IC 555, demodulator using transistor and to identify PPM waveform. ***Implement and study the same using SDR – Board*** **EXPERIMENT NO: 10** **NAME** Pulse Code Modulation (PCM) and Demodulation **AIM** To set up a PCM modulator and demodulator, and observe the waveforms **DESCRIPTION** After completing this experiment, the students will be able to set up a PCM modulator and to generate a PCM encoded output for a given analog input. ***Implement and study the same using SDR – Board*** **EXPERIMENT NO: 11** **NAME** Delta Modulation (DM) and Demodulation **AIM** To set up a DM modulator and demodulator, and observe the waveforms **DESCRIPTION** After completing this experiment, the students will be able to set up a DM and to generate a DM encoded output for a given analog input. ***Implement and study the same using SDR – Board.***

EXPERIMENT NO: 12
NAME
MATLAB Simulation for PCM Modulation and Demodulation
AIM
To Generate a PCM modulation and demodulation signals using MATLAB
DESCRIPTION
After completing this experiment, the students will be able to set up a PCM modulator and to generate a PCM encoded output using MATLAB.

EXPERIMENT NO: 13
NAME
MATLAB Simulation for DM modulation and Demodulation
AIM
To generate a DM modulation and demodulation signals using MATLAB
DESCRIPTION
1. After completing this experiment, the students will be able to set up a DM modulator and to generate a DM encoded output using MATLAB.

Communication Lab II (Digital Communication Lab)

EXPERIMENT NO: 1
NAME
Pseudo noise (PN) sequence generation
AIM
To generate a PN sequence and verify its auto-correlation property. **DESCRIPTION**
A. To generate a 15 length PN sequence using shift register (IC 7495)
B. To generate a 7 length PN sequence using flip-flop

To understand the random signals characteristics, it is important to generate a PN code sequence. In fact, a PN code sequence is a pseudo-random sequence of 1's & 0's, representing noise like carrier used for bandwidth spreading of the signal energy. It has properties equivalent those of white noise, and hence, it is interesting to verify its auto-correlation property. It can be utilized for the study of a direct-sequence spread-spectrum (DSSS) system.
Using GNU Radio on SDR board, generate the PN sequence.

EXPERIMENT NO: 2
NAME
Line coding and eye-pattern.
AIM
To study various line coding schemes and corresponding eye-

	patterns. **DESCRIPTION** A. The purpose of this experiment is to be familiarized with the basics of line coding, i.e., mapping bits to pulses B. Understanding the Nyquist criterion; transmission rates via bandlimited channels; assessment of maximum transmission rate In a digital communication system, the line coding is a part of digital signal processing that can be applied on the signal before it is connected to the analog signal. Line coding offers advantages in spectrum shaping, filtering, bit clock recovery, error detection, bandwidth usage & so on. The eye-pattern study helps in understanding that in digital communication systems, the clock or timing information must be recovered from the data at the receiver. **EXPERIMENT NO: 3** **NAME** Clock and data recovery scheme **AIM** To understand the clock and data recovery circuits. **DESCRIPTION** This experiment is intended to transmit a bit stream and recover the clock from bit stream itself at the receiver. In a digital communication system, the clock or timing information would be recovered from the data at the receiver. The clock recovery circuits employ some form of a phase-locked loop (PLL). **EXPERIMENT NO: 4** **NAME** Amplitude Shift Keying (ASK) Modulation and Demodulation **AIM** To set up ASK modulator and demodulator circuits and to observe the waveforms. **DESCRIPTION** ASK is a digital modulation scheme where the binary data is transmitted using a carrier signal with two different amplitude levels. For binary 0 and 1, the carrier switches between these two levels. In its simplest form, a carrier is sent 157 during one input and no carrier is sent during the other. This kind of modulation scheme is called on-off keying. After completing this experiment, the students will be able to a) set up ASK modulator and demodulator circuits and b) identify ASK waveforms. ***Implement the same on GNU Radio and SDR board*** **EXPERIMENT NO: 5** **NAME** Phase Shift Keying (PSK) Modulation and Demodulation **AIM**

	To set up Binary Phase Shift Keying (BPSK) modulator and demodulator circuits and to observe the waveforms. **DESCRIPTION** BPSK is digital transmission scheme where the binary data is transmitted using out of phase signals. During logic '0' a preset number of cycles of a sinusoidal carrier signal is transmitted and during logic '1' the same number of cycles of the carrier signal is transmitted but with 1800 phase shift. After completing this experiment, the students will be able to a) set up BPSK modulator and demodulator circuits and b) identify BPSK waveform. ***Implement the same on GNU Radio and SDR board*** **EXPERIMENT NO: 6** **NAME** Frequency Shift Keying (FSK) Modulation and Demodulation **AIM** To set up FSK modulator and demodulator circuits and to observe the waveforms. **DESCRIPTION** FSK is a digital modulation scheme where the digital data is transmitted using a high frequency carrier signal. For logic '0' and '1' the carrier signal switches between two preset frequencies, hence the name FSK. After completing this experiment, the students will be able to a) set up FSK modulator and demodulator circuits and b) identify FSK waveform. Implement the same on GNU Radio and SDR board. **EXPERIMENT NO: 7** **NAME** MATLAB simulation for Quadrature Phase Shift Keying (QPSK) Modulation and Demodulation **AIM** To generate a QPSK modulation and demodulation signals using MATLAB. **DESCRIPTION** As its name implies, QPSK is a variation of BPSK. QPSK is a DSBSC modulation scheme also but it sends two bits of digital information a time (without the use of another carrier frequency). After completing this experiment, the students will be able to a) set up a QPSK modulator and demodulator using MATLAB and b) identify QPSK waveform. ***Implement the same on GNU Radio, transmit the same on ISM band using SDR board.*** **EXPERIMENT NO: 8** **NAME** MATLAB simulation for ASK Modulation and Demodulation **AIM** To generate an ASK modulation and demodulation signals using MATLAB.

	DESCRIPTION After completing this experiment, the students will be able to a) set up a ASK modulator and demodulator using MATLAB and b) identify ASK waveform. **EXPERIMENT NO: 9** **NAME** MATLAB simulation for Differential Phase Shift Keying (DPSK) Modulation and Demodulation **AIM** To generate a DPSK modulation and demodulation signals using MATLAB. **DESCRIPTION** It is the version of BPSK. In DPSK, there is no absolute carrier phase reference, instead transmitted signal itself used as phase reference. After completing this experiment, the students will be able to a) set up a DPSK modulator and demodulator using MATLAB and b) identify DPSK waveform. ***Implement the same on GNU Radio, transmit the same on ISM band using SDR board.*** **EXPERIMENT NO: 10** **NAME** MATLAB simulation for FSK Modulation and Demodulation **AIM** To generate a FSK modulation and demodulation signals using MATLAB. **DESCRIPTION** After completing this experiment, the students will be able to a) set up a FSK modulator and demodulator using MATLAB and b) identify FSK waveform. **EXPERIMENT NO: 11** **NAME** SDR based channel performance measurements **AIM** Channel performance measurement in terms of Spectral Bandwidth, Symbol Rate, Bit Rate, Channel Capacity, Channel Utilization, Signal to Noise Ratio, Bit Error Rate (BER), Latency, Jitter, Eye Diagram, Constellation diagram **DESCRIPTION** After completing this experiment, the students will be able to understand all the channel performance measurement parameters. **EXPERIMENT NO: 12** **NAME** Source coding **AIM** To generate and evaluate the efficiency of variable length source coding using

	DESCRIPTION A variable length source coding like Huffman coding is an efficient coding technique for digital communications which depends on the frequency of occurrence of a data item. This can lead to a source code whose average code word length approaches the entropy H(x) of that source. **EXPERIMENT NO: 13** **NAME** Error Detection and Correction **AIM** To implement the error detection and correction codes to handle bit errors using MATLAB. **DESCRIPTION** Error detection and correction are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases.
Title	Digital Systems Design Lab
	1. VHDL simulation of Combinational logic circuits. 2. VHDL simulation of sequential logic circuits. 3. VHDL simulation of FSM. 4. Synthesis of combinational and sequential logic circuits. 5. FPGA implementation of Combinational and sequential circuits.
Mechanical Engineering Lab	
Title	Solid Mechanics Lab
	Exp.1 Experiments associated with tensile testing Exp.2 Experiments associated with torsion testing Exp.3 Experiments associated with buckling Exp.4 Experiments associated with hardness and micro-hardness testing Exp.5 Experiments associated with fatigue testing and impact testing Exp.6 Experiments associated with beam bending Exp.7 Experiments associated with strain gauges Exp.8 Experiments associated with photo-elasticity Exp.9 Experiments associated with creep test and biaxial loading experiments
Title	Fluid Mechanics and Machinery Lab

	Experiments for (i) Measurement of Friction factor in pipes for turbulent flow conditions, (ii) Evaluation of Losses due to pipe fittings, (iii) Measurement of force due to impact of jets, (iv) Demonstration of Bernoulli's Theorem, (v) Visualization of flow regimes in channels, (vi) Determination of laminar velocity profile and friction factor in pipe flow, (vii) Determination of performance characteristics of Francis turbine, Pellton turbine, centrifugal pump, and blower
Title	Machine Drawing
	Exp.1 Introduction to design process and drawings. Exp.2 Review of sectioning, Drawing standards, Dimensioning and notes. Exp.3 Fasteners and Joints: Screws, Bolts and nuts, Riveted joints, Pins, Locking devices, Welded joints, Pipe joints, Unions and valves. Cotter and Knuckle Joints. Assembly drawings with sectioning and bill of materials. Exp.4 Machine Assemblies: involving machine elements like shafts, couplings, bearing, pulleys, gears, belts, brackets. Detailed part drawings from assembly drawings. Engine mechanisms assembly and disassembly. Exp.5 Tool drawings including jigs and fixtures. Exp.6 Production drawings: Limits, Fits and Tolerances, Dimensional and geometric tolerances, Surface finish symbols. Exp.7 Layout drawings: Schematics, process and instrumentation diagrams, piping drawings. Exp.8 Structural drawings: examples for reading and interpretation. Exp.9 Computer aided drawing and drafting (CADD): use of software packages for engineering drawings and drafting.
Title	Manufacturing Processes Lab
	Exp.1 (a) Preparation of a core for producing a typical hollow-shaped part by the sand casting process. (b) Preparation of a Sand mold using the two-piece pattern and the core prepared in practical no.a, and production of the desired casting. **Exp.2** (a) To prepare a single 'V' butt joint using MIG/MAG welding process and die penetrant testing. (b) Welding Metallurgy (MIG/MAG) **Exp.3** Demonstration of non-traditional and CNC tools **Exp.4** Manufacturing of thread and cylindrical grinding. **Exp.5** Surface grinding and manufacturing of tapped holes in

	square plate
Title	Heat Transfer Lab
	Exp.1 Objective: 1 • Determination of coefficient of thermal conduction (thermal conductivity) of gases and liquids. Exp.2 Objective: 2 • Study of heat transfer in free and forced convection modes. • Study the forced convection: In this experiment, the effect of flow velocity on the convection heat transfer is observed by recording and calculating different parameters at different values of air flow velocity. Exp.3 Objective: 3 • To study the parameters governing steady state one dimensional heat conduction in radial direction and also to study the initial unsteady state heat conduction. Exp.4 Objective: 4 • Study of Different types of Heat Exchangers (Tubular, Shell and tube and Plate type HE) apparatus. • To investigate the effect of changes in hot and cold fluid flow rate on the temperature efficiencies and overall heat transfer coefficient. (For cocurrent and counter flow) • To investigate the effect of driving force with cocurrent and counter current flow. • To investigate the heat loss from Heat Exchangers by replacing the cold fluid by hot fluid and vice-versa. (For cocurrent and counter current flow) Exp.5 Objective: 5 • Study of one dimensional steady state linear heat conduction and understanding the significance of contact resistance. • Temperature distribution measurement for steady state conduction through a plane wall. • Temperature distribution measurement for steady state conduction through a composite wall and determine the overall heat transfer coefficient. • Determination of thermal conductivity of a metal specimen • To verify that the temperature gradient is inversely proportional to the cross sectional area for one dimensional conduction. • Demonstration of the effect of contact resistance on thermal conduction Exp.6 Objective: 6 • Determination and comparison of Thermal Conductivity of different insulating and building materials (Cork, Plaster, POM etc) Exp.7 Objective: 7 • Verification of different laws of radiation (Lambert's distance law, Lambert's direction law, Stefan Boltzmann's law and Kirchhoff's law)
Title	Applied Thermodynamics Lab
	Exp.1

	Objective:1 • To investigate the effect of cooling load on “Approach to wet bulb” and the application of the steady flow equation to selected systems to draw up energy and mass balances. • To investigate the effect of the packing density on the performance of a cooling tower and pressure drop across column **Exp.2** Objective: 2 • Demonstration of vapour compression refrigeration or heat pump cycle with visual observation of the important processes. • Study the effect of condenser load on vapor compression refrigeration cycle performance. • Study the effect of evaporator load on vapor compression refrigeration cycle performance. **Exp.3** Objective: 3 • Demonstration of the Rankine cycle • Study the effect of boiler pressure on turbine power output and calculation of efficiencies related to Rankine cycle **Exp.4** Objectives: 4 • To draw the following air conditioning processes on the psychometric chart and analyze them thermodynamically. • Sensible heating (ii) heating and Humidification (iii) Cooling and De-humidification. • To determine the energy and mass transfer rates at heater, boiler and refrigeration unit. • To study effect of adiabatic mixing of different quantities of air in two different states and plot on psychometric chart. **Exp.5** Objective: 5 • Study of jet engine **Exp.6** Objective: 6 • To study the performance of 4 cylinders, 4 strokes, Petrol engine coupled with eddy current dynamometer. • Calculate heat balance sheet for SI engine. **Exp.7** Objective: 7 • To study the performance of 4 cylinders, 4 strokes, Diesel engine coupled with eddy current dynamometer. • Calculate heat balance sheet for CI engine **Exp.8** Objective: 8 • To find the calorific value of a sample fuel using Bomb Calorimeter.
Title	Kinematics and Dynamics of Machines Lab
	Exp.1 Experiments on velocity Exp.2 Experiments on static force and acceleration analysis of mechanisms Exp.3 Experiments on friction Exp.4 Experiments on belt drives and cam-follower Exp.5 Experiments on balancing Exp.6 Experiments on bearings Exp.7 Experiments on gyroscopes Exp.8 Experiments on mechanical vibrations

Title	Instrumentation and Control Systems Lab
	Exp.1 Transducer Kit: a) Displacement measurement with electro-mechanical transducers b) Temperatures gradient measurement with Heat Transducers **Exp.2 Process control trainer:** Heating Element controlled by thyrisistor circuits **Exp.3 Michelson's Interferometer:** a) Calibration of Slip gauges b) Wavelength Measurement of monochromatic light c) Measurement of Change in pressure **Exp.4 Optical Instrumentation:** a) Characteristics of LDR b) Measurement of Groove spacing in a CD by its reflection grating c) optical based thickness measurement using Ellipsometry **Exp.5 Microprocessor based:** a) Basic Study b) DC motor position control Stepper motor Milli step interfacing with 8051microcontroller **Exp.6 Experimental implementation of different controller behavior in Swinging Pendulum Interfaced using MATLAB Simulink.** Digital PID controller based: a) Dc motor speed control module (fast process) b) Temperature control system (slow process) PLC based Interfacing of multiple cylinder sequences in electro pneumatic systems **Exp.7 Study on PLC based Interfacing of micro controlled XY** Stage for Laser based marking **Exp.8 Characteristics measurement using Impedance Analyzer** **Exp.9 Experiments in Hydraulic trainer kit** **Exp.10 Experiments on Optical fibre sensor kit** **Exp.11 Experiments on Autotronics trainer kit**
Title	Machining Science and Metrology Lab
	Exp.1 To find the wedge angle with the help of a sine bar Exp.2 Measurement of thread parameters using tool makers microscope Exp.3 To determine the temperature of tool-work interface using a tool work thermocouple Exp.4 Estimation of tool life of a HSS cutting tool during turning of C-20 steel bar using Taylor's relation Exp.5 Measurement of cutting forces by using lathe dynamometer Exp.6 Measurement of cutting forces by using drill dynamometer Exp.7 The effects of cutting velocity, nose radius and feed rate on surface roughness Exp.8 Effect of speed and feed on chip morphology

Title	Engineering Graphics
	Introduction to engineering drawing and orthographic projections; Projection of points and straight line; Projection of planes and solids; Projection of simple machine elements; Development of surfaces, Intersection of surfaces; Construction of isometric views from orthographic projections
Title	Basic Manufacturing Techniques
	1. Preparation of single piece casting. 2. Preparation of Lap joint in carpentry. 3. Preparation of joint by Arc welding & Gas welding. 4. Preparation of simple job by fitting tool & drilling. 5. Preparation of job on Lathe machine by turning, facing, knurling, drilling etc. 6. Basic Electrical Wiring system. 7. Investigating the casting and weld defects using nondestructive examination. 8. Characterize the defect size, location and distribution using ultrasonic method. 9. Determination of density of the given Casting using Archimedes method.
Civil Engineering Lab	
Title	Solid Mechanics Lab.
	Experiment on axial tension of mild steel and cast iron; compression on concrete; bending of beams; buckling of columns. Experiments on shear centre; continuous and interconnected beams; unsymmetrical bending of angle sections; buckling of columns of various cross-section and end conditions.
Title	Civil Engineering Drawing
	Drawing of various details of residential buildings, framed buildings in steel and concrete. Industrial and laboratory buildings. Principles of planning. Relation of frame work details, floors and roofing systems, masonry, load bearing and non-load bearing walls. Working drawings of building.
Title	Geodesy Lab-I
	Horizontal control-compass, plane table and theodolite traversing; plotting traverses and mapping details; vertical control-spirit levelling, tacheometry and trigonometric levelling; curve setting.
Title	Geodesy Lab-II

	Geodetic surveying; triangulation and precise levelling, theory of errors; method of least squares, adjustment of surveying observations; precision and accuracy evaluation; electronic measurements in surveying; field astronomy fundamentals. Spherical trigonometry, determination of terrestrial co-ordinates and Azimuth.
Title	Soil Mechanics Laboratory-I
	Identification of soils, Determination of physical properties, Consistency limits, Determination of soil permeability and compaction, characteristics of soils, Consolidation, Unconfined compression test, direct shear test, Vane shear test, Triaxial test, California bearing ratio test
Title	Soil Mechanics Laboratory-II
	Field Tests: Standard Penetration test, Plate Load, Dynamic Cone Penetration test, Multichannel analysis of surface wave test, Ground penetration radar, Electrical resistivity tomography
Title	Design Lab-I
	Design and drawing of continuous or two way slabs; continuous beam; column with a footing; joint details beam-slab; beam-column and columnfooting.
Title	Design Lab-II
	Design and drawing of built-up compression members; plate girder design, design and drawing of laced/battened columns with base plate; moment resistant designs.
Title	Engineering Geology Laboratory
	Geological Maps, Geological Mapping, outcrops, apparent and true dips, three point problems, depth and thickness problems, joints, faults, Megascopic and Microscopic identification of Minerals and Rocks, Engineering properties of rocks, refraction and resistivity methods, Guided tour through representative geological formations and structures.
Metallurgy Engineering and Materials Science Lab	
Title	Mechanics of Materials Lab
	Tensile tests on cylindrical or plate specimens; Fracture Mechanics tests; Fatigue Tests (axial and bending); Impact and Thermal Shock testing of the large area samples; Residual stress measurement; Fatigue tests (axial and bending); Modulus of Elatcicty, Flexural test; Poisson ratio flexural test; Cantilever

	flexural test
Title	Physical Metallurgy Lab
	Introduction to metallographic specimen preparation; Metallography and Image analysis; Optical microscopy of ferrous and non ferrous samples; Quantitative Metallography; X-Ray diffraction in material analysis; Nucleation, recovery and recrystallization behaviors analysis; Thermal analysis for phase transformation studies.
Title	Metal Forming Lab
	Experiments on Hot rolling; cold rolling open die forging, closed die forging, Deep drawing, Extrusion, super plastic forming, Hydro forming
Title	Polymer Technology Lab
	Polymer testing: Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance
Title	Welding and Foundry Engineering Lab
	GMA & MMA Welding Practice and Demonstration + TIG Welding Demonstration & Polymer Joining 1 Brazing and Gas Welding Practice and Demonstration Demonstration & Practice of thermocole pattern making, molasses mold making + Demonstration of green sand mold making, and metal pouring in both molds
Title	Corrosion Engineering Lab
	Principle of corrosion protection, methods of corrosion protection, better design, materials selection, barrier coatings, cathodic protection, anodic protection, inhibitor chemicals. Tools for corrosion inspection, corrosion monitoring, corrosion management
Title	Composites Development Lab
Course Syllabus	Fabrication of Metal Matrix Composites: Commonly used Matrices,Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stircasting & Compocasting,Screw extrusion, Liquid metal impregnation technique - Squeeze casting,Pressure infiltration, Lanxide process, Pinciple of molten

	alloy infiltration, rheological behaviour of meltparticle slurry, Synthesis of In situ Composites; Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites
Biosciences and Biomedical Engineering	
Title	Microbiology Lab
	1. Types of sterilization in laboratory. 2. Preparation of culture plates and uses of various medium to cultures micro-organisms. 3. Serial dilution and study of foci formation in bacteriology. 4. Various antibiotics selection and uses of appropriate antibiotics for various micro-organisms. 5. Isolation of RNA from Trizol methods. 6. Quantification of RNA through nano drop and gel methods. 7. RNA to cDNA conversion and setting up quantitative real time PCR 8. Analysis of quantitative real time PCR and explanation for housekeeping gene selection in various organelles. 9. Protein isolation and quantification through spectroscopy. 10. SDS PAGE electrophoresis, gel transfer and Immunoblotting.
Title	Molecular Biology & Genetic Engineering
	1. Primer designing for various experiments such as transcript measurements, cloning, etc. 2. Preparation of competent cells through calcium chloride methods. 3. Transformation of bacteria through heat shock methods. 4. Plasmid isolation through alkyl lysis methods. 5. Genomic DNA isolation from various sources. 6. Strategy of digestion for the cloning. 7. Setting up ligation reaction for cloning and selection of appropriate colony. 8. Colony PCR demonstration. 9. Strategy for point mutation and site directed mutagenesis. 10. In silico cloning methods.
Title	Virology & Microbiology
	1. Growing microaerophilic/anerobic bacteria in lab 2. Induction of Epstein Barr Virus in cell culture 3. Isolation & purification of EBV in lab.

	4. Determination of oral & gastric bacterial infection foci in lab. 5. Viral genome isolation. 6. Strategy for the identification of various viral genes. 7. Direct & indirect bacterial infection to human cells. 8. Viral & bacterial transcript determination. 9. Identification of mutations in bacterial strains. 10. Evaluation of antibiotic resistance bacterial strains.
Title	Tissue culture
	1. Cell culture media preparation and importance. 2. Working in bio safety level 1 and 2 for various pathogens. 3. Golden rules to start cell culture. 4. Determination of cell viability. 5. Strategy to grow floating cells. 6. Strategy for the isolation of primary cells. 7. Determination apoptosis & necrosis through microscopy. 8. Understanding the morphology of cells during in vitro culture. 9. Bacterial/fungal/mycoplasma contamination in cells. 10. Removal of contamination from cell culture.
Title	Bioinformatics/ Drug design & development
	1. Strategy for the design of drugs for COVID-19 and cancer. 2. Strategy for the design of drugs for Neurodegeneration and Malaria. 3. Preparation and identification of appropriate ligands. 4. Basic knowledge of PyMOL and CASTp. 5. Demonstration of Autodoc Vina for structure modelling. 6. Finding the active pockets and residues. 7. Understanding the poses in structure modelling. 8. Basics of Simulations. 9. Drug likeliness determination. 10. Understanding of cytotoxicity and determination of IC/LD 50 in in vitro culture.