8. LAB DETAILS

8.2 IC APPLICATIONS AND ECAD LAB

8.2 IC APPLICATIONS AND ECAD LLAB

8.2.1 OBJECTIVE AND RELEVANCE

The main objective of this lab course is to gain the practical hands on experience by exposing the students to various linear and digital IC applications. The students will have an understanding of the concepts involved in various linear integrated circuits and Digital ICs and their various applications.

8.2.2 SCOPE

Through this lab course the students will get a thorough understanding of various linear IC and digital ICs like 741operational amplifier, 555 timer, Voltage regulator IC 723, three terminal voltage regulators – 7805, 7809, 7912 7474, 74LS74, 74LS73, 74LS192, 74LS90, 74LS194/195, 74LS138, 74LS85, 74151, 74189, their various applications.

8.2.3 PREREQUISITES

Knowledge of Electronic Devices and Circuits analysis, switching theory and logic design is required.

8.2.4 PREAMBLE

This lab covers concepts related to Linear IC and Digital IC applications. They will also learn to simulate the internal structure of the Digital IC using VHDL/VERILOG. The students are adviced to go through the theory part in the mentioned reference books before doing the experiments.

8.2.5 JNTU SYLLABUS

PART-A (IC APPLICATIONS LAB):

EXPERIMENT No 1: OP-AMP Applications - Adder, Subtractor, Comparator Circuits

OBJECTIVE
Upon completion of the experiment student will be able to understand the various Op-AMP applications.

PRE-REQUISITE
Knowledge of electronic device and circuits, pulse and digital circuit’s lab.

THEORY
In the Op-AMP applications, the adder and subtract or circuit are constructed. It is shown that the op-amp can do addition and subtraction operations, the op-amp is configured in inverting and non inverting mode and is used to compare a sine wave with a reference voltage (positive and negative).

APPLICATIONS
Adder-Subtracter, differential amplifier.

EXPERIMENT No 2 : Integrator and Differentiator

OBJECTIVE
Upon completion of the experiment student will understand the Differentiation and Integration process using OP-Amp.

PRE-REQUISITE
Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY
The operational amplifier can be used in many applications. It can be used as differentiator and integrator. In differentiator the circuit performs the mathematical operation of differentiation that is the output waveform is the derivative of the input wave form for good differentiation. The circuit provides an output voltage which is proportional to the time integral of the input and R_1C_F is the time constant of the integrator.

APPLICATIONS
In Electronic Analog computation
In generation of step, ramp, square waveforms

EXPERIMENT No 3 : Active filter applications - LPF, HPF (first order)

OBJECTIVE
Upon completion of the experiment student will have an understanding of the filtering process. The pass band gain and the cutoff frequencies are measured and frequency response is plotted.

PRE-REQUISITE
Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY
In the low pass filter the higher end frequencies above the cutoff frequency are attenuated. In the high pass filter all the frequencies below the cutoff frequency are attenuated. The pass band gain and the cutoff frequency are calculated.

APPLICATIONS
Signal processing circuits.

EXPERIMENT No 4: RC Phase shift and Wien Bridge Oscillators using OP-AMPS.

OBJECTIVE
Upon completion of the experiment student will understand the RC Phase shift and wein bridge Oscillator Using IC 741 Op-Amp

PRE-REQUISITE
Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY
The Phase Shift Oscillator consist of an operational amplifier as the amplifying stage and three RC cascaded networks as the feed back circuits the amplifier will provide 180 degrees phase shift. The feed back network will provide another phase shift of 180 degrees.
The frequency of oscillation of the RC phase shift oscillator is then calculated in Hertzs

APPLICATION
These are used in sine wave oscillators for audio frequencies

EXPERIMENT NO 5: IC 555 Timer - Monostable Operation Circuits.

OBJECTIVE

Upon completion of the experiment student will have an understanding of the 555 timer as a monostable multivibrator mode.

PRE-REQUISITE

Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY

In this experiment the trigger input is applied to the monostable multivibrator and the square wave output waveform is obtained. The on time is calculated.

APPLICATION

Signal processing circuits, pulse width modulation, frequency divider.

EXPERIMENT No 6: SCHMITT TRIGGER CIRCUITS USING IC 741 & IC 555

OBJECTIVE

Upon completion of the experiment student will have an understanding of the 555 timer and IC741 as Schmitt Trigger circuits in the astable mode of operation.

PRE-REQUISITE

Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY

In this experiment the circuit for generating a square waveform. If positive feedback is added to the comparator circuit, gain can be increased greatly. Regenerative Comparator is also known as Schmitt Trigger.

APPLICATION

Signal processing circuits, This can be used as frequency divider

EXPERIMENT No 7: IC 565 – PLL applications

OBJECTIVE

Upon completion of the experiment student will have an understanding of IC 565. The 565 is available as a 14-pin DIP package. It is produced by Signatic Corporation.

PRE-REQUISITE

Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY

In this experiment the PLL is constructed using IC 565. The IC565 phase locked loop is an important building block of linear systems. It is used to measure the phase difference between the input and output frequencies.

APPLICATION

To construct missing frequency multiplier circuit

To construct AM demodulator circuit

EXPERIMENT No 8: Voltage Regulator using IC723, three terminal voltage regulators – 7805, 7809, 7912

OBJECTIVE
Upon completion of the experiment student will have an understanding of IC 723 voltage regulator, three terminal voltage regulators – 7805, 7809, 7912

PRE-REQUISITE
Knowledge of electronic device and circuits, pulse and digital circuits lab.

THEORY
In this experiment the IC 723 is studied. The voltage regulator application using this IC is observed. The line and load regulation are calculated for various input voltages and output loads respectively. The theoritical and practical line and load regulations are compared.

APPLICATION
Series voltage regulators.

PART (B)

TO VERIFY THE FUNCTIONALITY OF THE FOLLOWING 74 SERIES TTL ICS

EXPERIMENT No 1: **D Flip-Flop (74LS74) and JK Master-Slave Flip-Flop (74LS73)**

OBJECTIVE
Upon completion of the experiment student will have an understanding of the D Flip-Flop (74LS74) and JK Master-Slave Flip-Flop (74LS73)

PRE-REQUISITE
Knowledge of electronic device and circuits, Switching Theory and Logic Design, pulse and digital circuits lab. Student should have prior knowledge of Latches & Flip-flops, Pin configuration ,internal circuit and fuctioning of IC 7474.

THEORY
In this experiment the application of IC7474 and IC7473 as D flip-flop and JK Master-Slave Flip-Flop respectively is studied and understood the information on the D input is accepted by the flip-flops on the positive going edge of the clock pulse. The triggering occurs at a voltage level and is not directly related to the transition time of the rising edge of the clock. The data on the D input may be changed while the clock is low or high without affecting the outputs as long as the data setup and hold times are not violated. The J and K data is processed by the flip-flops after a complete clock pulse. While the clock is LOW the slave is isolated from the master. While the clock is HIGH the J and K inputs are disabled. Data transfers to the outputs on the falling edge of the clock pulse. A LOW logic level on the clear input will reset the outputs regardless of the logic states of the other inputs.

APPLICATION
Random Sequential circuits, Synchronizers for asynchronous input signals .

EXPERIMENT NO. 2 : Decade Counter (74LS90) and Up-Down Coutner (74LS192)

OBJECTIVE:
Upon completion of the experiment student will have an understanding of the Decade Counter (74LS90) and Up-Down Coutner (74LS192)

PREREQUISITES:
Student should have prior knowledge of Sequential circuits like Registers & Counters, Pin configuration internal circuit and functioning of IC 74LS90, 74LS192.

THEORY
The 7490 integrated circuit counts the number of pulses arriving at its input. The number of pulses counted (up to 9) appears in binary form on four pins of the IC. When the tenth pulse arrives at the input, the binary output is reset to zero (0000) and a single pulse appears at another output pin So for ten pulses in there is one pulse out of this pin. The 7490 therefore divides the frequency of the input by ten.

The 74LS193 is an UP/DOWN MODULO-16 Binary Counter. Separate Count Up and Count Down Clocks are used and in either counting mode the circuits operate synchronously. The outputs change state synchronous with the LOW-to-HIGH transitions on the clock inputs.

APPLICATIONS:
Asynchronous counters, clock generators and Frequency dividers.

EXPERIMENT NO. 3 : Universal Shift registers – 74LS194/195

OBJECTIVE:
Modeling, Simulation and synthesis of 74LS194/195 like Shift Register

PREREQUISITES:
Student should have prior knowledge of Sequential circuits like Shift Registers (SIPO, SISO,PIPO & PISO modes of operation), Pin configuration , internal circuit and operation of IC 7495.

DESCRIPTION:
IC 74LS194/195 is a versatile 4-bit shift register. It has facilities for parallel loading, parallel output, serial loading and serial output and additionally it has shift – left and shift – right (Bidirectional shift) facilities. This is, in effect a universal shift register which can operate in all four modes

APPLICATIONS:
Counters, Memories and Digital data transmission and reception.

EXPERIMENT NO. 4 : 3 to 8 – Decoder 74138

OBJECTIVE:
Modeling, Simulation and synthesis of 74138 like 3 to 8 – Decoder

PREREQUISITES:
Student should have prior knowledge of Combinational circuits like Decoder & Encoders, Pin configuration, internal circuit and operation of 3 to 8 – Decoder 74138

DESCRIPTION:
A Decoder is a multiple-input, Multiple-output logic circuit that converts coded inputs into coded outputs, where input and output codes are different. The IC 74138 is a commercially available MSI 3 to 8 Decoder.

It has active low outputs and three enable inputs (G1, G2A_L, G2B_L),all of which must be asserted for the selected output to be asserted.

APPLICATIONS:
Code converters,Demultiplexers and Memory Addressing .

EXPERIMENT 5 : 4 – Bit Comparator 74LS85

OBJECTIVE:
Modeling, Simulation and synthesis of 7485 like 4 – Bit Comparator

PREREQUISITES:
Student should have prior knowledge of Combinational circuits like Bit Comparators, Pin configuration, internal circuit and operation of 4 – Bit Comparator 7485

DESCRIPTION:
IC 7485 is a MSI 4-bit parallel comparator with three cascading inputs (AGTBIN,ALTBIN,AEQBIN) and three outputs(AGTBOUT,ALTBOUT,AEQBOUT). Both the cascading inputs and outputs are arranged in a one- out-of-three code

APPLICATIONS:
Used for Device identification, ALU and control unit

EXPERIMENT NO. 6 : 8X1 Multiplexer – 74151 and 2x4 Demultiplexer-74155

OBJECTIVE:
Modeling, Simulation and synthesis of 74151 like 8X1 Multiplexer and 2x4 Demultiplexer-74155

PREREQUISITES:
Student should have prior knowledge of Combinational circuits like multiplexers, demultiplexers, Pin configuration, internal circuit and operation of 8X1 Multiplexer – 74151 and 2x4 Demultiplexer-74155.

DESCRIPTION:
A multiplexer is a digital switch, it connects data from one out of n-inputs to its output based on the selection lines. The 74151 is a MSI 8 input, 1 bit multiplexer. The select inputs are named C, B, and A, where C is MSB. The enable input EN_L is active low; Both active high and active low versions of output are provided.
A demultiplxer is a digital switch in which one of the output will be selected based on the combination of input lines.

APPLICATIONS:
Digital switch for driving many sources on to single channel and vice versa, In ALUs and control units

EXPERIMENT NO. 7 : RAM (16X4) – 74189 (Read/write operations)

OBJECTIVE:
Modeling, Simulation and synthesis of 74189 like RAM (16X4) and to perform Read & write operations on RAM.

PREREQUISITES:
Student should have prior knowledge of Memories like ROMs & RAMs and its organization.

DESCRIPTION:

The IC 74189 is a 16 X 4 Static RAM. It contains 16 locations addressed by 4 Address lines and each location contains 4 – Bits of data (4 data lines).

Read operation: An address is placed on the address inputs while CS and OE are asserted. The latch outputs for the selected memory location are delivered to DOUT.

Write operation : An address is placed on the address inputs and a data word is placed on DIN; Then CS and WE signals are asserted. The latches in the selected memory location open, and the input word is stored.

APPLICATIONS:

used in the Design of Microprocessors and Microcontrollers.

8.2.6 Suggested Books

TEXT BOOKS

T1 Linear Integrated Circuits, D. Roy Chowdhury, III Edn, New Age International Pvt. Ltd.

T2. Op-Amps and Linear ICs, Ramakanth A. Gayakwad, III Edn, PHI.

T3. Digital Design-M.Morris Man

T4. Digital Logic Design – B. Holdsworth

T5. Digital Design Principles & Practices, John F. Wakerly

REFERENCE BOOKS

R1. Operational Amplifiers and Linear Integrated Circuits, RF Coughlin and Fredrick F. Driscoll., VI Edn, PHI.

R2. Integrated Circuits, Botkar, II Edn, Khanna Publications.

R3. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, McGraw Hill.

R4. A VHDL Primer - J . Bhasker.

8.2.7 WEBSITES

1. www.deas.harvard.edu
2. www.cam.ac.uk/admissions/undergraduate/courses/engineering/index.html
3. www.manchester.ac.uk/research/areas
4. www.eecs.umich.edu/eecs/research/resprojects.html
5. kabuki.eecs.berkeley.edu/papers.html

6. www.bbd_bestoff.com/importers.
7. www.ece.uiuc.edu
8. www.pearsoned.co.uk
9. www.vcapp.csee.usf.edu
10. www. vlsi.com
11. www.vlsi-inida.net
12. www.electronics - tutorials.com
13. www.semiconductors.phillips.com
14. www.eda.org/pub.
15. www.nitw.ernet.in

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8.2.9 LAB SCHEDULE: (GROUP-I)

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LAB SCHEDULE: (GROUP-II)

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