Jharkhand University of Technology, Ranchi

SYLLABUS

For Diploma Program in

ELECTRONICS AND COMMUNICATION ENGINEERING

(Effective from 2024-25)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

(3rd – SEMESTER)

Analog Electronics

Subject Code – ECE301

1. Rationale

Analog electronics is a branch of electronics that deals with a continuously variable signal. It is widely used in radio and audio equipment along with other applications where signals are derived from analog sensors before being converted into digital signals for subsequent storage and processing. Analog Electronics offers a very elegant design with many components and would effectively act as an impetus to the digital world.

2. Course Outcomes/Skill Sets: On successful completion of the course, the students will be able to:

CO-01	Identify the components in a given analog electronic circuit and list their characteristics and uses.
CO-02	Study the given analog circuit and using the data sheets/specification sheets, list alternative electronic components for the given circuit.
CO-03	Construct an analog electronic circuit for a given application and demonstrate the working of that circuit either in Real or Simulated environment.
CO-04	Test a given circuit for a desired result/outcome, identify the problem and troubleshoot to obtain the desired result/outcome.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1,3,4	1,3, 4,6, 7	Power Supplies 1.Need, Types – Unregulated, Regulated – Linear, Switched, Battery, Selection Criteria of different power Supplies 2. RPS & UPS – Online & Offline – Block Diagram and its working principle 3. SMPS – Block diagram and its working principle	Refer Table 1	1. Build 5V/12V Regulated Power Supply. 2a) Identify the components in a SMPS. 2b) Identify front panel control & indicators of UPS
2	1,3,4	1,3, 4,6, 7	Wave Shaping Circuits. 1. RC Integrator & RC Differentiator. 2. Clippers - Series, Shunt & Biased.	Refer Table 1	1. Generate the following waveforms from sinusoidal waveform. a. Trapezoidal waveform.
			3. Clampers – Positive Voltage & Negative Voltage, Voltage Multipliers – doubler, Tripler.		b. Positive Cycle. 2. Construct and verify voltage doubler and tripler circuit to multiply the input voltage.

3	1,2,3,4	1,3, 4,6, 7	Special Purpose Devices. 1. Features & Applications of Tunnel Diode, Varactor Diode. 2.Features & Applications of Gunn diode & PIN diode, Solar cell 3. Features & Applications of Schottky diode & UJT.	Refer Table 1	1. Identify & test all special purpose diodes and interpret their data sheets. 2. Simulate/Analyse Schottky diode/PIN diode/Gunn Diode/Varactor Diode application circuits.
4	1,2,3,4	2,3, 4,6, 7	Transistor Amplifiers. 1. Introduction, DC load line, Operating point, Need for biasing, Stabilization, stability factor. 2. Types of biasing-voltage divider bias for BJT. 3. Classification of Amplifiers-based on use, frequency, coupling methods & mode of operations (advantages, disadvantages)	Refer Table 1	1a. Demonstrate Numbering System of Semiconductor Devices. 1b. Identify Transistors in different packages and interpret their datasheets. 2a.Construct/Simulate a AND/OR Gate using transistors 2b. Design and construct voltage divider biasing circuit to fix an operating point and test the voltages
5	3,4	1,3, 4,6	1. Common Emitter Transistor Amplifier-Working, Voltage gain, phase reversal. 2. RC Coupled transistor amplifier-frequency response. 3. Power amplifiers- classification, principle & performance criteria of power amplifiers.	Refer Table 1	1.Construct voltage divider biased single-stage RC coupled CE amplifier and plot frequency response 2. Simulate the RC coupled amplifier using BJT. Verify the same using FET.
6	3,4	1,2, 5,6, 7	1. Working of Class A–Series-fed amplifier and transformer-coupled amplifier. Expression for output power and maximum power efficiency 2.Class B- Push pull Amplifier and complementary-symmetry push-pull amplifier. Expression for output power and maximum power efficiency. 3. Working of Class AB and Class C amplifiers. Stages of practical power amplifier, Concept and expression for voltage gain of multistage amplifiers.	Refer Table 1	1. Demonstrate and document the working of a power amplifier using video or simulator. 2. Construct and Demonstrate/Simulate the working of push pull amplifier. Verify the same using FET.
7	1,2,3	1,4, 6	1. Op-amp: Block diagram, Symbol, Basic differential amplifier- Working principle.	Refer Table 1	1. Identify Op-amp IC, its pins and Interpret its data sheet.

			2. Modes of operation-Single ended, Common mode & Differential mode, Ideal and practical characteristics. 3.Op-amp parameters: Input offset voltage, input offset current, power supply rejection ratio, CMRR, Input and output impedance, gain, gain-bandwidth product, slew-rate		2. Conduct an experiment to find the practical characteristics of Op-amp and compare them with ideal characteristics.
8	3,4	1,4, 6	1. Open-loop configuration: Comparator-inverting, non-inverting, applications, disadvantages. 2. Closed-loop configuration: virtual ground, applications - inverting, non-inverting amplifier. 3. Voltage follower, summing & difference amplifiers.	Refer Table 1	1. Construct and test an op-amp circuit to obtain Inverting & Non inverting output. 2. Construct a circuit to obtain the Sum/Difference of all input voltages.
9	3,4	1,3, 4,6	1. Construct and verify Op-amp as Differentiator, Integrator. 2. Op-amp as Schmitt trigger and precision rectifier, Gain of Multistage Op-Amp Circuits. 3. Sinusoidal Oscillators, Types of Oscillations, LC Tank circuit and stability.	Refer Table 1	1. Construct a circuit to obtain triangular wave and spike from square wave. 2. Build an op-amp circuit to generate clock pulses and verify its working.
10	3,4	1,3, 4,6	1. Concept of feedback and types, Barkhausen criteria. 2. Types of Oscillators, Working of Hartley oscillator using BJT/Op-amp and its applications. 3. Working of Colpitts and crystal oscillator using BJT/Op-amp and their applications	Refer Table 1	1. Construct/Simulate Hartley oscillator using BJT. Verify the same using op-amp. 2. Construct, test and Troubleshoot Colpitts oscillator using BJT/op-amp.
11	3,4	1,3, 4,6	1. Working of RC phase-shift and Wein-bridge oscillators using Op-amp and their applications. 2. Filters: Classification, Applications & Advantages of Active over Passive Filters. 3. Filter Terminology, frequency response of 1st order Butterworth LPF, HPF (No Derivation).	Refer Table 1	1. Design and implement /Simulate RC phase shift oscillator for generating a frequency of 1khz using BJT. Verify the same using op-amp. 2. Conduct an experiment to plot the frequency response of LPF & HPF.

12	3,4	1,3, 4,7	1. Frequency response of 1st order Butterworth BPF and Band Elimination Filter, BEF (No Derivation). 2. Instrumentation amplifier-Need for instrumentation amplifier, Working of instrumentation amplifier circuit. 3. Phase Locked Loop (PLL): voltage to frequency converter, PLL operation with mention of its applications	Refer Table 1	1. Build an Instrumentation Amplifier Circuit to detect and Amplify Analog/Bio-Potential Signals (using simulator or video to be displayed) 2. Verify the working of PLL using a simulator.
13	1,3,4	1,3, 4	1. IC 555 Timer: Internal diagram, Pin Configuration. Interpret Datasheets. 2. IC 555 timer as Astable multivibrator. 3. IC 555 timer as monostable multivibrator.	Refer Table 1	1. Verify the working of IC 555 timer as astable multivibrator. 2. Verify the working of IC 555 timer as monostable multivibrator.
Total in hours			**39**	**13**	**52**

LINKS FOR REFERENCE.

1. https://www.teamwavelength.com/power-supply-basics/
2. https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_smps.htm
3. www.electronicshub.org
4. https://images.app.goo.gl/xb2JnuqBKyaLgwi6A (Tutorial 6)
5. https://youtu.be/mgoCeOCjiBI (Experiment 7)
6. https://www.circuitstoday.com/
7. https://elec-club-iitb.github.io/blog/2016/09/get-electrified-2/
8. https://bestengineeringprojects.com/frequency-shift-keying-fsk-generator-using-pll-565/
9. https://images.app.goo.gl/cbkCDCHJngANwiyF6
10. http://www.allaboutcircuits.com
11. http://www.allaboutcircuits.com/videos

E-WEBSITES FOR REFERENCE

1. Electronic Tutorials
2. Spark fun-Learning section
3. All about circuits
4. Electronics theory
5. Electronics Lab
6. Instructables

4. Reference:

Sl. No.	Description
1	1. Electronic Devices and Circuits, S. Salivahanan , N. Sereshkumar , McGraw Hill Education (India) Private Limited, ISBN - 9781259051357
2	Op-amps and linear integrated circuits, Ramakanth A. Gayakwad, ISBN- 9780132808682
3	Principles of Electronics, Rohit Mehta and V K Mehta, S. Chand and Company Publishing, ISBN-9788121924504
4	Electronic Devices and Circuits, David A. Bell, Oxford University Press, ISBN9780195693409
5	Fundamentals of Electrical and Electronics Engineering, B. L. Theraja, S. Chand and Company Publishing. REPRINT 2013, ISBN-8121926602.

5. Equipment/software list

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	MATLAB /PSPICE/Electronic Workbench Software for simulation		
3	Regulated Power Supply (Single)	1A/2A 0-30V	
4	Regulated Power Supply (Dual)	1A/2A 0-30V	
5	DC Voltage supply	(+/-5v, +/-12V, +/-15V	
6	Digital multimeters		
7	Function/Signal generator		
8	Dual trace oscilloscope	Upto 20-30MHz	
9	Electronic consumables (Diode, Transistor(npn and pnp), Resistors, Inductors, Capacitors, Special purpose diodes,etc)		
10	Step down transformers	6-0-6v 12-0-12v	
11	OP-amps	741 IC	
12	IC 555		
13	Single strand wire/ patch cards	Different lengths	
14	Probes		
15	Breadboard/Analog trainer kit		

Logic Design using Verilog

Subject Code – ECE302

1. Rationale

Digital Electronics is a field of electronics involving the study of digital signals and engineering of devices that use or produce them. It is very important in today's life because if digital circuits are used instead of analog circuits the signals can be transmitted without degradation due to noise. Also in a digital system information stored is easier than that of analog systems. The functionality of digital circuits can be changed easily with the help of software without changing the actual circuit. Verilog, a Hardware Description Language, is used for describing digital electronic circuits and systems. It is used for verification of digital circuits through simulation, for timing analysis, for test analysis and for logic synthesis**.**

2. Course Outcomes: On successful completion of the course, the students will be able to:

CO-01	List the types of Verilog modeling and the use of each model for specific application
CO-02	Design and construct a sequential circuit for a given application and test the circuit to obtain the desired result/output.
CO-03	Compare and contrast combinational and sequential circuits and simulate a given circuit using Verilog descriptions to test to obtain the desired result/output
CO-04	List the various types of A to D, D to A converters along with memory and for a given application select the appropriate converters and/or memory types to be used to obtain the given result/output.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1	1,4,5, 6,7	1. VLSI - Introduction, Importance & Need. HDL- Introduction, Importance, Need & Types. 2. Introduction to Verilog HDL, Types of modeling- Switch level, Structural, Data flow and Behavioral. 3. Basic Concepts- Lexical conventions, comments, keywords, identifiers, strings.	Refer Table 1	1. Familiarization of Xilinx software. 2. Familiarization of FPGA/CPLD KIT.
2	1	1,2,4	1. Data types -Value Set, Wires, Nets, Registers, Vectors, Integers, Real, Time, Parameters, Arrays, Strings. 2. Operators- Arithmetic, Logical, Relational, Bit-wise. 3. Reduction, Shift, Concatenation, Replication, Conditional operators. Operator Precedence.	Refer Table 1	1. Demonstrate and Practice simple examples using different data types. 2. Compute the output for expressions having different operators using simple programs.

3	1,3	1,2,3,6	1. Program structure- Module declaration, port declaration, port connection. 2. Gate level modeling for basic gates. 3. Gate level Verilog description for half adder, full adder.	Refer Table 1	Write the verilog code, simulate and download to FPGA/CPLD kit for the following 1. 2 input basic gates using gate level modelling. 2. Full adder and full subtractor using gate level modelling.
4	1,3	1,2,3,4,6	1. Data flow modeling- Continuous assignment, Module instantiations, net declaration, delays, expressions. 2. Data flow Verilog description of multiplexer and demultiplexer. 3. Data flow Verilog description for 4-bit comparator	Refer Table 1	Write the verilog code, simulate and download to FPGA/CPLD kit for the following. 1. 4:1 Mux and 1:4 Demux using data flow modeling. 2. Comparator using data flow modeling.
5	1,3	2,3,4,6	1. System tasks-display, strobe, monitor, reset, stop, finish. Compiler directives- include, define. Behavioral modeling- Always and Initial statements. 2. Procedural Assignments- Blocking and non-blocking assignments. Timing Control-Delay, Event 3. Conditional statements-if, if-else, Case, Loops- While, For, Repeat, Forever.	Refer Table 1	1a.Write and execute simple programs to illustrate conditional statements. 1b. Write and execute simple programs to illustrate loops. 2. Write the verilog code, simulate and download to FPGA/CPLD kit for a 4-bit ALU with any 2 arithmetic and logical operations.
6	1,3	1,2,3,4,6	1. Behavioral Verilog description for BCD to seven segment decoder for common anode display using if- else, Case. 2. Traffic light controller using Behavioral description. 3. Test bench- Need, Importance, testbench for half adder.	Refer Table 1	1. Write the verilog code, simulate and download to FPGA/CPLD kit for a BCD to seven segment decoder using case statement. 2. Write and simulate a Test bench for half adder.
7	2	1,2,3,4,6,7	1. Sequential circuits - Introduction. Flip flops- types, SR flip flop- Gate level circuit using NAND gates, truth table, working, timing diagram.	Refer Table 1	1. Construct and test clocked SR Flip flop using NAND gates in digital trainer kit.

			2. JK, JK-MS flip flops-Logic circuit, truth table, working, timing diagram. 3. D, T flip flops-Logic circuit, truth table, working, timing diagram. Relevance of Asynchronous inputs to flip-flops.		2. Implement D and T Flip flops using JK flip flop in digital trainer kit and observe the timing diagram.
8	2,3	1,2,3, 4	1. Verilog description of SR flip flops using data flow modeling. 2. Verilog description of JK flip flop using behavioral modeling. 3. Registers- Classification of registers, realization of simple (3 or 4 bit) SISO using flip-flops.	Refer Table 1	Write the verilog code, simulate and download to FPGA/CPLD kit for the following. 1. SR, JK flip flops using data flow modeling 2.D, T flip flops using behavioral modeling
9	2,3	1,2,3, 4,6,7	1. Realization of SIPO, PISO and PIPO using flip flops. 2. Concept of universal shift-register. Ring counter and Johnson's counter (3 bit). 3. Verilog description of any one shift register using any modeling.	Refer Table 1	Construct and verify the working of the following using suitable IC in digital trainer kit 1. SISO, SIPO, PISO and PIPO(4-bit) shift registers. 2. Ring and Johnson counter(4-bit).
10	3	1,3,4, 6,7	1. Counters - definition, classification, modulus. Working and realization of asynchronous (3 bit/4 bit) counters using flip-flops. 2. Working and realization of synchronous (3-bit/ 4-bit) counters and their comparison. 3. Realization of partial mod (mod n) counters-asynchronous, synchronous.	Refer Table 1	Construct and verify the working of the following using digital trainer kit 1. 3 bit ripple counter using IC 7476. 2. 4 bit counter as a frequency divider.
11	3,4	1,2,6, 7	1. Realization of higher-mod counters using lower-mod counters. Concept of up/ down counters. 2. Verilog description of any one counter using any modeling. 3. Data converters- Need for DAC and ADC, DAC specifications, types, working of Weighted resistor type.	Refer Table 1	1. Write the verilog code, simulate and download to FPGA/CPLD kit for an up/down counter using behavioral modeling. 2. Construct/Simulate and verify the working of R-2R DAC.
12	4	1,2,3, 4,6,7	1. ADC specifications. types, working of Flash ADC.	Refer Table 1	1. Construct/Simulate and verify the working of Flash ADC.

			2. Working of Successive approximation and dual slope ADCs. 3. Memory devices- Introduction, classification based on different criteria, read and write operations.		2. Illustrate the storing and retrieving of data in RAM using suitable IC.
13	4	1,2,3, 4,7	1. Introduction to PLDs- PAL, PLA, CPLD, FPGA, ASIC. IC Design Verification – Types & Stages. 2. PAL- Architecture, Implementation of a Boolean expressions using PAL. 3. PLA-Architecture, Implementation of a Boolean expressions using PLA.	Refer Table 1	1. Implementation of Boolean expressions using PAL. 2. Implementation of Boolean expressions using PLA.
Total in hours			**39**	**13**	**52**

LINKS.

1. https://verilogguide.readthedocs.io/en/latest/verilog/testbench.html
2. https://youtu.be/XES0QUi8ttY(week 11, exp 2)
3. https://www.youtube.com/watch?v=krmXg-WTbIU (week 12, exp 1)
4. http://www.asicguru.com/verilog/tutorial/system-tasks-and-functions/68/.
5. https://youtu.be/vHlg_QLGIQ (week 7,exp 3)
6. https://youtu.be/AtX5x53FcLI (week 9,exp 3)
7. https://youtu.be/Bx_4rsUAGoM
8. https://www.irisys.net/people-counting.

5. Reference:

Sl. No.	Description
1	Fundamentals of Digital Logic with Verilog Design by Stephen Brown and Zvonko Vranesic
2	Verilog HDL by Samir Palnikar
3	Introduction to Verilog-Peter M Nyasulu
4	Verilog Tutorial-Deepak Kumar Tala

6. Equipment/software list

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	Xilinx software		
3	Digital trainer kits		20
4	Verilog kits		20
5	Dual trace oscilloscope	20-30MHz	10
6	Digital multimeters		05
7	Patch cards	different length	250
8	Digital IC Tester		02

9	ICs 7400,7402,7404,7408,7432,7486,7442, 7445,7446,7474,7476,7427,7489,7490, 7494,7495,74141,74148,74153,74157, 74155,74193,74194,DAC0808,ADC-0800,741		10 each

Communication Systems

Subject Code – ECE303

1. Rationale

The communication system describes the information exchange between any two points. The process of transmission and reception of information is called communication. Without communication the world ceases to exist. Information or Data can be transmitted and received across any part of the world by adapting suitable techniques, process and medium, hence making the world reachable and smaller through Technology.

2. Course Outcomes : On successful completion of the course, the students will be able to :

CO-01	Identify all the components of a communication system, list their role and characteristics in the system.
CO-02	Propagate a signal through a transmission medium to obtain a desired output for given conditions in the communication system.
CO-03	Construct an analog/digital communication system for a given application and demonstrate its working either in a Real or Simulated environment.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1	1,4,5	**Network theorems** 1. Superposition theorem- statement and explanation with an example. 2. Maximum Power Transfer theorem- statement and explanation with an example. 3. Thevenin's theorem and Norton's theorem-statements and explanation with an example each.	Refer Table 1	1. Construct and verify maximum power transfer theorem. 2. Construct and verify Thevenin's theorem.
2	1,3	1,2,4,6	**Resonance** 1. Series resonance - circuit diagram, phasor diagram, resonance plot and characteristics. 2. Condition for series resonance, expression for frequency of resonance. Parallel resonance- circuit diagram, phasor diagram. 3. Parallel resonance-resonance plot and characteristics, Condition for resonance, expression for frequency of resonance.	Refer Table 1	1. Construct a series/parallel resonant circuit and plot its frequency response. 2. Construct a series/parallel resonant circuit and find its bandwidth and Q factor.

3	1,3	1,2,4,6	**Filters** 1. Classification of filters, cut-off frequency, pass band and stop band. 2. Ideal characteristics curve of passive LPF, HPF, BPF and BRF. 3. Circuit diagram & formula for cut-off frequency of T and Π configurations of LPF and HPF.	Refer Table 1	1. Construct and test the passive low-pass T-type filter circuit for a given cut-off frequency. 2. Construct and test the passive high pass Π -type filter circuit for a given cut-off frequency.
4	1,3	1,2,4,6	**Attenuators** 1. Classification and applications of attenuators. Definition of Bel, Decibel and Neper. 2. Symmetrical T type attenuator- Circuit diagram, expression for attenuation. 3.Symmetrical Π type attenuator- Circuit diagram, expression for attenuation	Refer Table 1	1. Construct and test T type attenuator circuit for the given attenuation & Ro. 2.Construct and test Π type attenuator circuit for the given attenuation & Ro.
5	1,2,3	2,3,4,5	**Transmission Media** 1. Need, different types of transmission media(guided, unguided), Transmission lines- Electrical model, Primary constants - R, L, G and C , Secondary constants - Characteristic Impedance and Propagation Constant. 2. Optical fiber -principle of operation, Numerical aperture, Angle of acceptance, Classification, fiber losses. 3..Basic components of Fiber optic system, splices, connecters , couplers and switches.	Refer Table 1	1. Demonstrate PC to PC communication using Fiber Optic Digital Link. 2. Demonstrate installation , testing, repair and power budgeting of fiber optic cable (using simulator/video)
6	1,2,3	1,4,5,6	**Antennas** 1. Concept of electric and magnetic fields in a dipole, antenna terminology- polarization, radiation pattern, antenna gain, directive gain, directivity, power gain, antenna resistance.	Refer Table 1	1. Video demonstration and documentation on the working of the dipole antenna and observe its radiation pattern.
			2. Antenna efficiency, beam width, bandwidth, isotropic radiators. Effects of ground on antennas, effect of antenna height, Antenna types, examples and applications. 3. Working of Dish Antenna, Feed mechanisms-Cassegrain and Horn feed.		2. Video demonstration and documentation of antenna types with examples and applications.

7	2,3	1,4,5,6	**Wave Propagation** 1. Wave Propagation: Fundamentals of Electromagnetic Waves, electromagnetic spectrum. 2. Modes of wave propagation-ground wave propagation and sky wave propagation and space wave propagation, comparison. A**nalog modulation** 3. Block diagram of communication system, Need for modulation and types of analog modulation techniques.	Refer Table 1	1. Video demonstration and documentation on the fundamentals of electromagnetic waves and electromagnetic spectrum. 2. Video demonstration and documentation on the need for modulation and demodulation techniques.
8	3	1,2,3,4,6	1. AM Transmitter and Receiver -block diagram & waveforms. 2. Expressions for modulating signal, Carrier signal, modulated signal, modulation index and power. 3. Frequency Transmitter and Receiver-block diagram, waveform, Expressions for frequency deviation, modulation index.	Refer Table 1	1. Construct and verify amplitude modulation and demodulation using kit. 2. Construct and verify frequency modulation and demodulation using kit.
9	1,3	1,3,4,5,6,7	**Digital communication** 1. Block diagram of digital communication system. Definition of information capacity, entropy, bit-rate, baud rate and bandwidth of digital data. 2. Sampling- Sampling theorem for low pass and band pass signals, Nyquist criterion and aliasing effect. 3. Explain Analog pulse modulation techniques-PAM, PPM, PWM using waveforms.	Refer Table 1	1. Verify sampling theorem for low pass signals using kit. 2. Conduct an experiment to study the effect of aliasing using kit.

10	1,3	1,2,3,4,6	**Digital Coding** 1. Quantization -process, classification. Quantization noise and companding process. 2. PCM and DPCM system. 3. Delta modulation and adaptive delta modulation system.	Refer Table 1	1. Perform an experiment to study Pulse Code Modulation and Demodulation using kit. 2. Generation of Delta modulated signal using kit.
11	1,3	1,2,4,6	1. Baseband transmission - significance of inter symbol interference (ISI) and eye pattern. Digital modulation techniques-types. 2. Generation and detection of Binary ASK and Binary FSK. 3. Generation and detection of Binary PSK and QPSK.	Refer Table 1	1. Perform an experiment to generate and detect BASK signal using kit. 2. Perform an experiment to generate and detect BPSK signal using kit.
12	1,3	1,2,6,7	**Multiplexing** 1. FDM & TDM- concept applications 2. PAM/TDM system -Block diagram, transmission bandwidth, synchronization, crosstalk and guard time. 3. Digital multiplexers-Principle, classification and performance factors.	Refer Table 1	1. Demonstrate TDM using Fiber Communication System. 2. Video demonstration and documentation of FDM and TDM.
13	3	1,2,4,6	**Error detection & correction** 1. Errors-types, redundancy, error control schemes. 2. Error control codes- types, Parity check bit coding, error detection methods-LRC. 3. VRC, CRC, Checksum with examples.	Refer Table 1	1. Video demonstration and documentation of error detection and correction. 2. Video demonstration and documentation on LRC, VRC, CRC.
Total in hours			**39**	**13**	**52**

Links.

1. https://www.gopracticals.com/electrical/basic-electrical/verify-thevenin-theorem/
2. https://youtu.be/Ok7DJGuOulQ
3. https://youtu.be/B_u3sGbpM8M
4. https://documentcloud.adobe.com/link/review?uri=urn:aaid:scds:US:3d5cab35-a6d0-49e4-b4b3-06c745d34d98
5. https://www.wikihow.com/Design-a-Simple-Antenna
6. https://youtu.be/r4NikIMA4dQ
7. https://youtu.be/8P6DBAxbQxY
8. https://youtu.be/00ZbuhPruJw

5. **Reference:**

Sl. No.	Description	
1	Electronic communications	- George Kennady
2	Advanced Electronics Communication System.	- Wayne Tomosi
3	Understanding communication systems	- Texas Instruments
4	Fiber Optic Communication Systems,	- Dr.R.K.Singh, Wiley India
5	Principles of Electronic Communication Systems	- Louis E. Frenzel, Tata McGraw Hill
6	Digital and analog communication systems	- K.Sham Shanmugam, Wiley India

6. Equipment/software list

Sl. No.	**Particulars**	**Specification**	**Quantity**
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	MATLAB/PSPICE/Electronic Workbench Software Simulator		
3	Amplitude modulation and demodulation trainer kits		
4	Frequency modulation and demodulation trainer kits		
5	Generation and detection BASK,BFSK,BPSK trainer kits		
6	Regulated Power supply	(1A/2A, 0-30V)	
7	Dual trace oscilloscope	up to 20 to 30MHz	
8	Digital multimeters		
9	Function/Signal generators		
10	Step down transformer, Capacitors, Resistors, Inductors, BJT, Opamp IC-741, Regulator IC-7812, Diode		
11	Single strand wire/Patch cards (different lengths)		
12	Probes		
13	Analog trainer kit		
14	DC Voltage supply	(+/-5v, +/-12V, +/-15V)	
15	Kit to demonstrate Sampling theorem and aliasing effect		
16	Kit to demonstrate PCM		
17	Delta Modulation and Detection trainer kit		
18	Adaptive Delta Modulation and Detection trainer kit		

19	Optical fiber communications trainer kit to cover all the experiments.		
20	Computers	Pentium and higher,8GB RAM,512 HDD	
21	Tool kit		

Electronic Measurements and Testing Techniques

Subject Code – ECE304

1. Rationale

The instruments used to measure any Electrical/Electronic quantity are known as measuring instruments. The standards of measurements are very useful for calibration of measuring instruments. They help in minimizing the errors in the measuring systems. Testing Techniques are means of enhancing troubleshooting and the ability to learn skills. It keeps electronic equipment in working condition and ensures safety. The damage of the equipment can be significantly reduced.

2. Course Outcomes : At the end of the Course, the student will be able to:

CO-01	List the types of measurement and common errors that occur while using electronic measuring systems and demonstrate use of statistical analysis to validate specific output from measuring and testing equipment.
CO-02	Explain the standards used for calibration and demonstrate calibration of a measuring and/or testing equipment to ensure it provides reliable output.
CO-03	Select an appropriate sensor or transducer for a given application and demonstrate its use to measure and record the readings for a given project.
CO-04	Test a given lab equipment, identify the reasons for error, troubleshoot or calibrate to ensure the equipment provides the correct reading

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1.	1	1,4,6	1. Necessity of measurements-direct and indirect methods, Static characteristics of an instrument. 2. Dynamic characteristics of an instrument. Generalized electronic measurement system-Block diagram. 3. Errors–classification of errors, sources of errors.	Refer Table 1	1. Find the static characteristics of analog voltmeter/ multimeter. 2. Find the dynamic characteristics of analog voltmeter/multimeter.
2	1, 2, 4	1,4,5, 7	1. Statistical analysis- arithmetic mean, deviation, average deviation, standard deviation, probability of errors and limiting errors. 2. Problems on Statistical analysis.	Refer Table 1	1. Identify the errors and do the calibration for setting up an analog multimeter before performing measurement.
			3. Calibration, Error check, understand specification sheet of digital multimeter.		2. Troubleshoot and service the Digital trainer kits.

3.	1, 2, 4	1,4 ,5	1. Standards-primary, secondary, working and IEEE standards. 2. Bridges- Comparison of AC and DC bridges. Applications of AC and DC bridges. 3. Wheatstone bridge-Explanation and applications.	Refer Table 1	1. Build a Wheatstone bridge to find unknown resistance. 2. Construct a circuit to measure AC voltage by voltage divider method.
4	2, 3	1,2 ,3, 4,6	1. Electrical Transducers- necessity, selection, classification- active and passive, analog and digital, primary and secondary. 2. Strain gauge-principle, gauge factor, features of bonded, unbonded, foil type strain gauges. 3. Load Cell, capacitive transducer-principle & features.	Refer Table 1	1. Video demonstration and documentation on multi-function meter used for measuring any electrical parameter. 2. Calibrate a load cell to measure the weight of any object. Use suitable components and/or programming to accomplish the task.
5	2, 3	3,4 ,5, 7	1. Hall effect transducers, LVDT, thermistor. 2. Thermocouple, piezoelectric transducers, position sensors. 3. Proximity sensors, digital optical encoders & PIR sensors.	Refer Table 1	1. Build a temperature sensor circuit using a thermistor. 2. Build a simple application using position/proximity sensor.
6	1, 2	1,4 ,7	1. PMMC meters- principle, DC ammeters and multi range ammeters. 2. DC voltmeters using PMMC, multi range voltmeters, loading effect and voltmeter sensitivity. 3. Electrodynamometer -principle, ammeter, voltmeter.	Refer Table 1	1. Construct a circuit to verify KVL and measure voltages using analog voltmeter. 2. Construct a circuit to verify KCL and measure currents using analog ammeter.
7	1, 2	1,4 ,5, 7	1. Electronic voltmeter- Chopper amplifier type voltmeter. 2. AC voltmeter- full-wave rectifier, Peak responding and true RMS voltmeters. 3. Ohmmeters- series and shunt type, concept of calibration of meters.	Refer Table 1	1. Study of Regulated DC power supply and measurement of standard voltages at various stages of RPS. 2. Identify and rectify the various faults in the Regulated DC power supply.

8	1, 4	1,2 ,4, 5	1. Digital instruments –Introduction, Ramp type DVM. 2. Automatization in digital meters- automatic polarity indication, automatic decimal point positioning, automatic ranging and zeroing. 3. Electronic counters-block diagram.	Refer Table 1	1. Video demonstration and documentation on testing life cycle of electrical loads using Electronic Counter. 2. Troubleshoot and perform minor repair practices on Decade Boxes (Rotary switches, connectors, components connectivity etc).
9	1, 2, 4	1,4 ,5, 6	1. Digital frequency meter, Time interval measurement. 2. Digital LCR meter, digital multimeter. 3. Microprocessor based instruments, IEEE 488 GPIB instruments.	Refer Table 1	1. Calibrate LCR meter and perform measurement of Resistance, capacitance, and inductance and verify with actual value. 2. Troubleshoot and rectify any analog circuit using simulation software (Multisim)
10	1, 2, 4	1,4 ,5, 6	1. Cathode Ray Oscilloscope-block diagram, working of CRT. 2. Dual trace CRO, CRO probes, applications of CRO. 3. DSO-block diagram, features, Sampling oscilloscope.	Refer Table 1	1. Study the front panel controls of CRO and do its calibration 2. Demonstrate the use of CRO to measure phase difference between two waveforms and obtain the lissajous patterns.
11	1, 2, 4	1,4 ,7	1. Function generator- block diagram and applications. 2. Standard RF signal generator, sweep frequency generator. 3. Harmonic distortion, harmonic analyzing instruments.	Refer Table 1	1. Demonstrate the analysis of different waveforms (amplitude, phase, frequency) from a function generator using CRO. 2. Demonstration and documentation on the working of a spectrum analyser. (Video/simulator)
12	1, 4	1,5 ,7	1. Electrical grounding and shielding- concept, interference, shielding of cabinets. 2. Precautions to prevent instrument damage, general precautions for instrument safety. 3. Testing and troubleshooting- introduction, generalized troubleshooting.	Refer Table 1	1. Do it yourself (DIY) a probe and use the probe to test the circuit continuity in PCB.

13	1, 2, 4	1,4 ,5, 7	1. Precautions to be taken to achieve personnel safety during servicing. 2. Testing Techniques, electronic repair tools. 3. Explain Basic steps of electronic equipment service and maintenance. a) Study of basic procedure of service and maintenance b) Circuit tracing techniques	Refer Table 1	1. Do it yourself (DIY) an antistatic wrist strap useful to handle electronic component.
Total in hours			**39**	**13**	**52**

LINKS

1. https://www.webassign.net/labsgraceperiod/ncsuplseem2/lab_1/manual.html
2. https://youtu.be/i4sI_dBWH50
3. https://blog.matric.com/pcb-testing-methods
4. https://www.youtube.com/watch?v=AUTcWsR6pwU
5. https://www.youtube.com/watch?v=x4B6 1C4gEQ
6. https://www.youtube.com/watch?v=-0Pre73mp7A
7. https://www.youtube.com/watch?v=lgvCMd5nMw4
8. https://www.youtube.com/watch?v=Evw5AqUYJcg
9. https//www.youtube.com/watch?v=yasajLJUYvg

5. Reference:

Sl. No.	Description
1	Electronic Measurements and Instrumentation -2nd Revised Edition, R. K. Rajput, ISBN: 81- 219-2917-2 234.
2	Electronic Measurements and Instrumentation-3rd Edition, Sanjay Talbar & Akhilesh Upadhayaya, ISBN :81-874-3335-3
3	Electronic Instrumentation -3rdEdition, Kalsi H. S., ISBN: 00-707-0206-3
4	Modern Electronic Instrumentation and Measurement Techniques-2nd Edition, Albert Helfrick & William Cooper, ISBN:81-203-0752-6

6. Equipment/software list

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	MATLAB/Multisim/PSPICE/Electronic Workbench Simulation Software		
3	Dual trace oscilloscope	20-30MHz	
4	LCR meter		
5	Multi function meter		
6	Resistors, Capacitors, Inductors ,Thermistor		
7	Digital multimeter		
8	Analog multimeter		
9	Function generator		
10	Position, and Proximity sensors		
11	Transducer		
12	Load cell		
13	Tool kit		
14	Soldering set		

(4th – SEMESTER)

PCB Design & Fabrication

Subject Code – ECE401

1. Rationale

Printed Circuit Boards (PCBs) are the core component in almost all the electronic gadgets used either for domestic or industrial purposes. PCBs hold almost all electronic components necessary for a device to function. Using a PCB has many advantages such as compact design, ease of testing and repair, low noise and interference, and improved reliability. Apart from electrically connecting, it also gives mechanical support to the electrical components. Using PCBs, a highly complicated circuit can be designed in a very small package which helps in reducing the size of electronic devices.

PCB design can be done either manually or using software. Electronic design automation tools are software tools used for designing the schematic and layout of PCB. Large number of PCBs can be fabricated at the same time after the layout is designed once. With consumers pushing for slimmer and faster devices, and with industries seeking improved functionality, the PCB will continue to develop in the future.

2. Course Outcomes: On successful completion of the course, the students will be able to:

CO-1	Identify different types of Printed Circuit Board (PCB), list the differences between them and its adequacy for specific application.
CO -2	Draw the schematic and PCB layout for an analog circuit to be used for a given application.
CO-3	Select the right components for a designed circuit, build the circuit and fabricate it using the appropriate tools following all necessary safety protocols.
CO-4	Test the fabricated circuit, identify the problem and troubleshoot to ensure the circuit provides the desired output.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1	1	1. Introduction to PCB, need and evolution of PCBs. 2. Classes of PCB – First Class (RF, microwave, and analog PCB) & Second Class (digital based PCB) – characteristics. 3. Types of PCB - Single sided, double sided and multilayer PCBs, rigid and flexible PCBs.	Refer Table 1	1. Familiarization of any Electronic design automation (EDA) software -Open source EDA Tool KiCad. 2. Practice the PCB design steps for a simple analog circuit: Schematic design-Familiarization of schematic editor, schematic creation, annotation, electrical rule check, mapping of components, netlist generation.
2	1,2	1	1. Comparison between single layer, double layer and multilayer PCBs. 2. Importance of grounding in PCBs, impedance matching, reflection, ground bounce, SSN. 3. Materials used for multilayer PCBs, PCB thickness, aspect ratio.	Refer Table 1	1. Practice placement of components. 2. Practice the routing (normal tracks -10 mils and power tracks-50 mils).
3	1,2	1,2	1. Component package types - Through-Hole, Surface-Mount, Fine Pitch, FPGA, QFT, TFP, BGA, Press Fit. 2. Calculation of track width required for different types of packages. 3. Types of Planes in PCB.	Refer Table 1	1. Learn how to create symbols for diodes, transistors, connectors, ICs. 2. Create the footprint for diodes, transistors, connectors,ICs.
4	2	2,3,4	1. Design for manufacturability (DFM). 2. Electromagnetic Interference (EMI), Electromagnetic Compatibility (EMC). 3. Thermal issues in PCB	Refer Table 1	1. Design Schematic for Regulated Power supply. 2. Design PCB layout for Regulated Power supply.

5	2	2,3,4	1. Conduction, convection, radiation in thermal issues. 2. Heat Dissipation in PCB, Heat sinks. 3. RF PCB-introduction.	Refer Table 1	1. Design Schematic for inverting /summing amplifier using op-amp. 2. Design PCB layout for inverting /summing amplifier using op-amp.
6	2	2,3,4	1. High-speed digital basics. 2. General design factor for digital and analog PCBs. 3. Voltage and current considerations in PCBs.	Refer Table 1	1. Design Schematic for astable multivibrator using IC 555. 2. Design PCB layout for astable multivibrator using IC 555.
7	2	2,3,4	1. Transmission lines, significance of transmission line and its effects. 2. Types of Transmission lines. 3. Different types of termination techniques, simple problems.	Refer Table 1	1. Design Schematic for RC coupled amplifier. 2. Design PCB layout for RC coupled amplifier.
8	2	2,3,4	1. Crosstalk in transmission lines, minimization of crosstalk. 2.ENIG and ENEPIG. 3. Noise budget.	Refer Table 1	1. Design Schematic for a given circuit (Ex: proximity sensor/ LED blinking/+ or -12v power supply using 7812 IC and 7912 IC) 2. Design PCB layout for a given ckt (Ex:proximity sensor/LED blinking circuit/+or - 12v power supply using 7812 and 7912 IC)
9	2,3	3,4,,5	1. Preparation of Manufacturing Drawing (MD). 2. Importance of Solder mask, assembly drawing, silkscreen, Gerber file. 3. Board origin, component origin, importance of origin.	Refer Table 1	1.Familiarisation of copper clad sheet, drilling machine, drill bits, required chemicals .(links) 2. Generate the Gerber file of works done in weeks 4 - 8 and take printouts on glossy paper.

10	2,3,4	4,5	1. Importance of CNC machines. CNC machines for component pick and place, drill file. 2. Design for Testing(DFT) 3. Design specification standards.	Refer Table 1	Fabrication process.
11	2,3,4	7	1. Steps involved in fabrication of single side PCB. 2. Steps involved in fabrication of double sided PCB. 3. Steps involved in fabrication of multilayer PCB.	Refer Table 1	Fabrication process.
12	2,3,4	7	1. Steps involved in fabrication of multilayer PCB- continued. 2. Soldering techniques. 3. Testing of PCB.	Refer Table 1	Fabrication process.
13	2,3,4	7	1. Importance of RoHS (Restriction of use of Hazardous Substances). 2. Waste management of hazardous materials in PCB. 3. Environment Management Standards (EMS).	Refer Table 1	Fabrication process.
Total in hours			**39**	**13**	**52**

5. Reference:

Sl. No.	Description
1	Printed Circuits Handbook - 6th edition Clyde F. Coombs,Jr.
2	PCB Design & Technology - Walter C. Bosshart
3	Printed Circuit Board by RS Khandpur, Tata McGraw Hill Education Pvt Ltd., New Delhi
4	Electronic Product Design Volume-I by S D Mehta, S Chand Publications
5.	Open source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/
6	PCB Fabrication user guide page: http://www.wikihow.com/Create-Printed-Circuit-Boards http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself

6. Equipment/software

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	Open source EDA Tool KiCad.		
3	Single-sided copper clad sheet.		
4	Diluted Acidic solution for copper etching purpose with plastic tray.		
5	Tapes and pads for layout design of different dimensions.		
6	Glossy paper		
7	Hand drilling/Power drilling machine.		
8	Tool kit (Tray, Brush, PCB Laminate, tong, hand gloves etc.)		

Wireless Communication

Subject Code – ECE402

1. Rationale

The purpose of wireless communication is to communicate messages over distances without the use of wires. It includes an exposure to microwave engineering, radar systems, cellular and satellite communication. In the microwave industry, job opportunities are available in assembly, production, installation, repair and maintenance of microwave transmitters and receivers. The knowledge of radar systems allows opportunities with civil and defence organizations dealing with aircraft and shipping. Satellite communication is used to relay signals around the curvature of Earth allowing communication between widely separated points. Mobile communication is a fast changing technology which offers voice and data connectivity between individuals.

2. Course Outcomes: On successful completion of the course, the students will be able to:

CO-1	Identify the types of wireless communications, list differences and its applications.
CO-2	Identify the components of a given wireless communication system, explain the role of those components in the system and list their characteristics.
CO-3	Build a working model of a wireless communication system to be used for a specific application.
CO-4	Test a given set top Box / mobile phone, identify the problem and troubleshoot to ensure the device is fully functional.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1,2, 3	1	1. Wireless communication – Concept, block diagram, types, frequency spectrum used in different wireless communication systems. 2. Wireless metropolitan area network(WMANs), Wireless local area networks(WLANs), Wireless personal area network – (WPANs) 3. Wi-Fi- Features and applications, significance of hotspot.	Refer Table 1	1. Implement WLAN in your computer lab.
2	1,2, 3	1,3	1. RFID- concept & applications. 2 Bluetooth – components, connections, networking & applications. 3. Waveguides- Need, types, applications.	Refer Table 1	1. Conduct an experiment to connect PC to internet through bluetooth access point of mobile and transfer a text file/image file/video file. 2. Interface RFID reader for any application using Arduino controller.

3	1,2, 3	1,5	1. Microwave signals, microwave devices –Two cavity klystron, Reflex klystron. 2. Magnetron and Travelling Wave Tube (TWT) and their applications. 3. RADAR- principle of operation and applications.	Refer Table 1	1. Video demonstration & documentation on working of a. Two cavity klystron. b. Reflex klystron. 2. Video demonstration & documentation on working of a.Magnetron. b.TWT.
4	1,2, 3	1,2	1. Radar range equation (no derivation) and factors influencing the radar range. 2. Pulsed radar system- principle and block diagram, Duplexer. 3. Antenna scanning and tracking.	Refer Table 1	1. Study and measure the characteristics of pulse from signal generator using a CRO. 2. Conduct an experiment to use a smart phone as CCTV camera (or a CCTV camera) and connect it to another mobile to view the camera feed.
5	1,2, 3	1,5	1. Special purpose Radars- doppler radar, MTI radar-block diagram and their applications. 2. Secondary surveillance radar & ILS. 3. ZigBee –architecture, network topologies, applications.	Refer Table 1	1a.Video demonstration and documentation to understand radar scanning and tracking systems. b. Video demonstration and documentation to understand the working of secondary surveillance radar. 2. Interface Zigbee module for any application using Arduino controller.
6	1	1,5	Satellite Communication 1. Satellite - Types, orbits. apogee and perigee, azimuth and elevation angles, sub satellite point, sub satellite paths, ascending and descending nodes. 2. Posigrade and Retrograde orbits, Uplink and downlink, orbital period and radius of geosynchronous satellite, satellite eclipse. Polar and Geostationary satellites - advantages and disadvantages. 3. LEO, MEO & GEO satellites, Station keeping, Attitude control and thermal control	Refer Table 1	1. Study the features and working of different sections in a satellite communication trainer kit. 2. Conduct an experiment to Transmit & Receive three separate Signals (Audio, Video, and Tone/ Voice) simultaneously through satellite link and perform Link Fail Operations using satellite communication trainer kit.

7	1,2	1,5	1. Satellite communication system- block diagram. Transponder- single conversion, double conversion and regenerative transponder. 2. Increasing channel capacity- frequency reuse and spatial isolation. Communication satellite- satellite subsystems. 3. Earth station- block diagram, Applications payload.	Refer Table 1	1. Find the delay between Uplink transmitter and Downlink receiver during data transmission using satellite communication trainer kit. 2. Demonstrate working of satellite transponders using satellite communication trainer kit.
8	1,2, 3	1,5	1. Global Positioning System (GPS) –features, working. 2. Satellite for TV applications - Direct-To-Home (DTH) and cable TV. 3. Satellite for military applications, VSAT – features & applications.	Refer Table 1	1. Video demonstration and documentation on a. Working of GPS System b. Working of Satellite TV. 2. Conduct an experiment to tabulate latitude, longitude, Plus codes of different locations using a GPS receiver in mobile phone and learn sharing of live locations.
9	1,2, 4	1,5,7	1. Satellite for voice and data communication, Earth observation. 2. Set top box -concept, block diagram. 3. Set top box - working.	Refer Table 1	1. Video demonstration and documentation of TV Set top box repair. 2. Test and troubleshoot Set top box.
10	1,2	1,5	1. Cellular networks, cellular concept, frequency reuse. 2. Terminologies used in mobile communication. capacity expansion techniques-cell splitting and cell sectoring. 3. Handoff strategies. working of a typical cellular system.	Refer Table 1	1. Conduct an experiment to understand the working of different sections in a mobile phone using a mobile phone trainer kit. 2. Conduct an experiment to analyze MIC & Speaker section, Buzzer section using a mobile phone trainer kit.
11	3	7	1. GSM services and features. 2. GSM architecture, working. 3. LTE architecture and working.	Refer Table 1	1. Conduct an experiment to analyse vibrator section, LED control section using a mobile phone trainer kit. 2. Conduct an experiment to analyse the active mode/sleep mode/Partially ON mode while charging of a mobile phone using a mobile phone trainer kit.
12	1,2, 4	7	Mobile servicing 1. Mobile displays – working principle.		Video demonstration and documentation of

			2. Mobile camera – working principle. 3. Charging ports & battery - concept	Refer Table 1	1. Troubleshooting, testing and replacement of display, front camera. 2. Troubleshooting, testing and replacement of charging port, battery.
13	1,2, 3	7	1. IoT – introduction, characteristics of IoT, internet of things. 2. IoT protocols-MQTT, IoT-functional blocks. 3. IoT communication models, IoT enabling technologies.	Refer Table 1	1. Build an IoT based simple real time application using Arduino controller and prepare a report.
Total in hours			**39**	**13**	**52**

LINKS

1. https://youtu.be/Q97bVxd2r10
2. https://youtu.be/Fvud81pYGOg
3. https://youtu.be/bUsS5KUMLvw
4. https://youtu.be/4-wp_M1z4ls
5. https://youtu.be/qzBPSG1b5uo
6. https://youtu.be/H00_PVX2bRw
7. https://youtu.be/wCcARVbL_Dk
8. https://youtu.be/OpkatIqkLO8
9. https://youtu.be/AiT36qdoSCc.
10. https://youtu.be/oEa0Pfxl4C8
11. ttps://youtu.be/1JZG9x_VOwA
12. https://youtu.be/iS8jmhVAfoQ.
13. https://youtu.be/2UujN_pOcYI
14. https://youtu.be/iQeaK0NGMnA
15. www.ifixit.com-> Repair guides->select the particular model for ref.

4. Reference:

Sl. No.	Description
1	Microwave Devices and Components by Sylio, Prentice Hall of India, New Delhi
2	Wireless Communications (Principles and Practice), by Thedore Rappaport
3	Wireless Communications and Networking, by William Stallings
4	Mobile Communication by John Schiller, Prentice Hall of India, New Delhi

5. Equipment/software list with Specification for a batch of 20 students

Sl No	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	MATLAB Software		
3	Dual trace oscilloscope	Up to 20-30MHz	
4	CAT5 cable		

5	RJ 45 connectors		
6	Arduino microcontroller board		
7	RFID Reader , Tag		
8	ZigBee Module		
9	Satellite Communication trainer kit	Uplink Transmitter, Inbuilt tone generator Satellite Link, Downlink receiver.	
10	TV Set up box		
11	Mobile phone trainer kit	Onboard Section: Keypad, Dual SIM, Charging Circuit, User interface: Buzzer, Vibrator, Mic, Speaker, Hands free port and display LEDs	
12	Not- working mobile phones		

Embedded C Programming

Subject Code – ECE403

1. Rationale

C is a general purpose programming language which is robust and highly portable used for scripting system applications which form a major part of all operating systems**.** C language is available on a very wide range of platforms, from embedded microcontrollers to supercomputers**.** Microcontroller is a compressed microcomputer manufactured to control the functions of embedded systems in various fields such as automobile, aeronautics, robotics, mobile communication, electronic appliances, industrial processing, defense, space, medical applications etc. The future of the micro controller depends on machine learning in embedded systems.

2. Course Outcomes: On successful completion of the course, the students will be able to:

CO1	Write the code using C constructs for a given requirement, execute the program, debug and to demonstrate that the program produces the required result/output.
CO2	List the various components and the characteristics of each component in a 8051 Microcontroller.
CO3	Write an embedded program for a given requirement, test and troubleshoot to obtain the desired output.
CO4	Identify the right microcontroller/peripheral device using data sheets / specification sheets for a given application.

3. Course Content

Week	C O	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1	1,2, 3	1. Introduction to C - features, compilation process. 2. C tokens, variables and identifiers, constants. 3. Data types - classification, memory requirement, range of values, usage.	Refer Table 1	1. Familiarisation of TURBO C. 2. Programs to illustrate the use of different data types and verify their memory size.
2	1	1,2, 3	1. Operators and Operands- Arithmetic, logical, relational operators. 2. Unary, conditional, assignment and special operators, precedence and associativity. 3. Basic input and output functions, format specifiers, preprocessor directive & library functions	Refer Table 1	1a.Compute simple interest given the principal, interest rate and duration. b. Compute compound interest given P,t,r,n. 2a. Compute the area of a circle, square, rectangle and triangle. b. Swap contents of two variables without using intermediate variables.

3	1	1,2, 3	1. Flowchart and Algorithm, Structure of a C program, simple C programs. 2. Branching- conditional -if, if-else, example programs. 3. Nested if-else, switch, example programs.	Refer Table 1	1a.Compute the largest of three numbers using if-else and ternary operators. b.Compute the result of a student using nested if. 2. Given the resistance and tolerance, generate the color bands of the resistor using a switch statement.
4	1	1,2, 3	1. Looping- for, while, do-while loops. 2. Example programs on looping. 3. Arrays- definition, declaration, initializing single dimensional arrays. Examples.	Refer Table 1	1a.Compute factorial of a single digit number. b. Compute the sum of digits of a given 3 digit number reducing it to a single digit. 2. Sort an array of numbers in ascending order and descending order.
5	1	1,2, 3	1. Strings- declaration, initialization with an example. Two dimensional arrays- declaration, initialization with an example. 2. Functions- elements of user defined functions, example. 3. Pointers- introduction with example. Structures- introduction with example.	Refer Table 1	1a. Compute the length of a string and reverse the string using string functions. 1b. Compute the sum of two matrices. 2a. Compute cube of a number using a function. 2b. Store the details of an employee using a structure and print the details
6	2	1	1. Introduction to the concepts of embedded systems, microprocessors, microcontrollers. 2. Selection of 8 bit, 16 bit, 32 bit, 64 bit microcontrollers. Introduction to 8051 microcontroller. 3. Architecture of 8051 microcontroller, PSW and special function registers.	Refer Table 1	1. Identification of program development tools. 2. Familiarization of program development using Keil.
7	2	1,2, 3	1. Memory organization, general purpose RAM, bit addressable RAM. 2. Register banks, Pin details of 8051.	Refer Table 1	1. Familiarize with the structure of the 8051 assembly program and executing it.
			3. Interfacing external data and code memory.		2. Write and execute simple ALP to understand different addressing modes.

8	3	1,2, 3	1.8051 Addressing modes. 2. Instruction set- classification, syntax and function of data transfer instructions, 3. Arithmetic instructions, Logical instructions.	Refer Table 1	1.Write and execute an ALP to (a) Move a block of data within internal RAM (b) Exchange a block of data between internal RAM and external memory. 2. Write an ALP to (a) evaluate simple arithmetic expression such as y= (((5*2)-(4+1))/3) %2. (b) Perform addition of three 8-bit BCD numbers to result in BCD form.
9	3	1,2, 3	1. Bit level instructions, jump instructions. 2. Introduction to Embedded C and its applicability to 8051. 3. General structure of embedded C program, data types.	Refer Table 1	1.Write an ALP to (a) Rotate or shift 16-bit data. (b) Evaluate simple logical expression such as Y= a&&b||c^!d where a, b, c and d are 8-bit data. 2.Write and execute an assembly and embedded C program to convert (a)Packed BCD to unpacked BCD (b) Unpacked BCD to packed BCD.
10	3	1,2, 3	1. Memory types and models, pointers, pointer's memory type. 2. Time-delay generation using loops, example program. 3. Arithmetic and logical operators, example programs.	Refer Table 1	1. Write and execute a program to search a given 8-bit number in an array of N numbers using embedded C. 2. Write and execute a program to toggle a particular bit in the internal RAM with the use of delay subroutine.
11	3,4	7	1. Features of I/O ports. Interface I/O devices such as LED, buzzer with programs. 2. Polling & interrupt methods, executing an interrupt, IE and IP registers. 3. Enabling, disabling and priority setting, example programs.	Refer Table 1	1. Write and execute an embedded C program to toggle the LED/buzzer with tone using push-button switch. 2. Write ALPs to enable, disable and priority setting of interrupts and

					verify it in IE and IP registers.
12	3,4	7	1. Bit structure and function of TMOD and TCON registers, mode 1 operation of timers. 2. Time delay generation & example programs. 3. Bit structure of SCON register, SBUF register, TI and RI flags, working of serial port for data transmission and reception.	Refer Table 1	1. Write and execute an embedded C program to generate a square wave on P1.2 using timer 0 in mode 1 to generate delay. 2. Observe the square wave of the above program on CRO by downloading the program to the microcontroller kit.
13	3,4	5,7	1. Interfacing 8051 to Multiplexed seven-segment display with assembly/C program. 2. Interfacing 8051 to ADC 0804, waveform generation using DAC 0808 with assembly/C program. 3. Interfacing 8051 to DC motor, Stepper motor with assembly /C program.	Refer Table 1	Interfacing experiments 1. Program to control direction and speed of a stepper motor/ dc motor. Study the data sheets of stepper motor/dc motor. 2. Program to control traffic lights **OR** Program to generate sine/ rectangular / triangular wave-forms.
Total in hours			**39**	**13**	**52**

5. Reference:

Sl. No.	Description
1	C Programming By Kernighan and Dennis Ritchie 04.
2	C Programming By Balaguruswamy, TMH Publishers, ISBN-10: 8131716813, 2009.I
3	Scott MacKenzie and Raphael C.W. Phan. The 8051 Microcontroller. (4/e), Pearson education, 2008.
4	Kenneth J Ayala, The 8051 Microcontroller, (3/e), Thomson Delmar Learning.

6. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	TURBO C		
3	8051 Microcontroller kits		
4	Interfacing kits		

Industrial Automation

Subject Code – ECE404

1. Rationale

Automation in the industrial workplace provides the advantages of improving productivity and quality while reducing errors and waste, increasing safety, and adding flexibility to the manufacturing process. Industrial automation results in increased productivity, more efficient use of materials, increased safety, reliability, better product quality, shorter workweeks for labour, profitability and reduced factory lead times. Worker safety is an important reason for automating an industrial operation**.** A wide range of industrial controls and automation depends on power electronics. PLC is an industrial computer control system used to control the state of output devices based upon a custom program. SCADA is a centralized system that monitors and controls field devices at remote sites.

2. Course Outcomes: On successful completion of the course, the students will be able to

CO-01	Explain the role and importance of power electronics in today's industrial automation and for a given application list the commonly used components in power electronics.
CO-02	Build a power electronic circuit and demonstrate the working of that circuit for a specific application either in a real or simulated environment.
CO-03	Design, test and troubleshoot a given PLC automation system to meet defined operational specifications in a simulated environment.
CO-04	Explain the concept of SCADA, DCS and HMI and list their various applications in industry.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
1	1	1	1. Introduction to industrial automation, need for power devices, features of power diode, power BJT. 2. Features of SCR, IGBT and Power MOSFET. 3. DIAC and TRIAC - working, applications.	Refer Table 1	1. Conduct an experiment to find the holding current and latching current of SCR. 2.Conduct an experiment to determine break-over voltage of an SCR.
2	1,2	1	1. Triggering-Need, Triggering circuits- R-triggering, RC–triggering.	Refer Table 1	1. Construct a R triggering circuit and verify its working.
			2. Pulse triggering using UJT relaxation oscillators. 3. Commutation-Need, natural and forced commutation of SCR. resonant commutation.		2. Construct a R-C triggering circuit and verify its working.

3	1,2	1,3	1. Auxiliary commutation and Complementary commutation. 2. Protection of SCR-Snubber circuit- turn ON, turn OFF and over- voltage. 3. Controlled rectifiers- Single phase half-wave controlled rectifier, single phase full-wave bridge controlled rectifier (only resistive load), importance of freewheeling diode.	Refer Table 1	1. Verify SCR triggering by UJT relaxation oscillator using a kit. 2. Construct a full-wave controlled rectifier circuit using R-C triggering and verify its working.
4	1,2	1,3	1. Chopper- working principle, duty cycle, chopper control schemes. 2. Chopper classifications, Step-up and Step-down choppers. 3. Working of first quadrant, second quadrant choppers.	Refer Table 1	1. Verify the working of a constant frequency voltage commutated chopper using a kit. 2. Verify the working of a variable frequency voltage commutated chopper using a kit.
5	1,2	1,3	1. Working of two quadrant and four quadrant choppers, Buck and Boost converters. 2. Inverters- working principle and types, Half-bridge inverter. 3. Full-bridge inverter, Series inverter,	Refer Table 1	1. Verify working of series inverter using a kit. 2. Verify working of full bridge inverter using a kit.
6	1,2	1,3	1. Variable dc link inverter, voltage source and current source inverters. 2. PWM techniques used in inverters. 3. Cycloconverter- classification, working of single phase to single phase midpoint cycloconverter.	Refer Table 1	1. Verify PWM techniques in inverters using a simulator. 2. Verify single phase to single phase cycloconverter using a kit.
7	1,2	1,3	1. Photo-electric control of SCR, Light dimmer circuit using DIAC and TRIAC. 2. Burglar alarm circuit. Need for electronic control of motors. 3. Armature voltage control method and Field control method for speed control of DC shunt motor.	Refer Table 1	1. Verify light dimmer circuit using DIAC and TRIAC. 2. Simulate and verify the working of Burglar alarm circuit/Photo electric control of SCR/Speed control of DC shunt motor.

8	2,3	1,3,5	1. Speed control of DC motors using dual converters, speed control of Induction motor. 2. PLC-introduction, compare Relay logic control and PLC logic control, block diagram of PLC system, PLC scanning. 3. Internal architecture of PLC, memory organization.	Refer Table 1	1. Verify the speed control of universal motor using a kit. 2. Verify the speed control of stepper motor using inverter in clockwise and anti-clockwise direction using a kit.
9	3	1,3,5	1. PLC input devices – switches, proximity sensors, photoelectric sensors, temperature sensors, liquid level sensors. 2. PLC output devices – solenoids, relay, directional control valve, motors & stepper motors. 3. Programming standards, PLC Ladder diagram, ladder diagram for logic gates.	Refer Table 1	1. Familiarization of software for PLC simulation (Keyence/Picosoft). 2. Write ladder diagrams and verify the truth table of all logic gates.
10	3	3,5,7	1. PLC input instructions and outputs- coils, indicators, Conversion of Boolean functions from word description to ladder diagram and vice-versa. 2. Write the ladder diagrams for different applications Ex i. A system where there has to be no output when any one of four sensors gives an output, otherwise there is to be an output. ii. Staircase light application. iii. Conveyor control application. 3. PLC register basics- Input, Holding, Output, PLC arithmetic functions- addition, subtraction, multiplication & division.	Refer Table 1	1. Write a ladder diagram for DOL starter and test the output using PLC trainer kit module. 2. Simulate and test the following task using PLC, A signal lamp is required to be switched ON if a pump is running and the pressure is satisfactory, or if the lamp test switch is closed, otherwise the signal lamp should remain OFF.
11	3	3,5,7	1. PLC Basic comparison functions and its applications. 2. PLC Timer functions- on delay timer, off-delay timer, pulsed timer , one shot, applications of timing functions in process control. 3. PLC Counter functions- up/down counter, applications of	Refer Table 1	1. Write a ladder diagram, timing diagram and simulate a circuit for the following process control application. There are 3 mixing devices on a processing line A, B and C. After the process begins mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 seconds after A. Mixer- C is to start 5 seconds after B. All of them remain ON until a master enable switch is turned OFF.

			PLC counter functions in process control.		2. Write a ladder diagram and simulate a circuit for a process control application in which a paint spray has to run for 40 seconds when the count reaches the value of 25.
12	3,4	3,5, 7	1. PLC and the internet, selection of PLC and its maintenance, PID module. 2. Distributed Control System-Introduction, features, hierarchical architecture, advantages. 3. DCS application in chemical plants/ cement plants/ paper and pulp industries, Introduction to HMI/MMI.	Refer Table 1	1. Write the ladder diagram and execute the Water level controller/Staircase light controller application using PLC trainer kit module. 2. Video demonstration and documentation of DCS application in any plant.
13	4	3,5, 7	1. SCADA-Introduction, background, definition, features, typical SCADA system. 2. SCADA architecture, SCADA hardware & software. 3. SCADA protocols, interfacing PLC with SCADA. applications of SCADA.	Refer Table 1	1. Write the ladder diagram and execute the Lift control/Conveyor control application using PLC trainer kit module. 2. Video demonstration and documentation of the SCADA systems.
Total in hours			**39**	**13**	**52**

5. Reference:

Sl. No.	Description
1	"Programmable Logic Controllers Principles and Applications" by John W. Webb – Ronald A. Reis. 5th Edition, Published by PHI Publication.
2	"Introduction to PLC's" by Gary Dunning, 3rd Edition, Thomson India Edition
3	"PLC's" by W. Bolton, 4th edition.
4	Programmable Logic Controllers by Frank D Petruzella, 4th Edition, McGraw Hill Publications.

6. Equipment/software list

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	
2	POWERSIM simulation software		
3	Kit for SCR triggering by UJT relaxation oscillator		
4	Kit for Voltage commutated chopper both constant frequency & variable frequency.		
5	Series Inverter kit		
6	Full bridge inverter kit		
7	PWM inverter kit		
8	Single phase to Single phase cyclo converter kit		
9	Light Dimmer kit		
10	Speed control of universal motor kit		
11	Speed control of stepper motor kit		
12	PLC kits		
13	PLC interfacing kits for Lift control, water level control		