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		