Teaching Scheme and Syllabus

For

Bachelor of Technology

In

Minor in Electronics and Communication Engineering

(for Mechanical, Civil, and Chemical Engineering students)

Department of Electronics Engineering

Sardar Vallabhbhai National Institute of Technology

Minor in Electronics and Communication Engineering

(for Mechanical, Civil, and Chemical Engineering students)

Sr. No.	Semester	Subject	Code	Schema	Credit	Notional hours of Learning (Approx.)
1	IV	Analog Electronics	EC222	3-0-2	04	85
2	V	Digital Electronics and Microcontrollers	EC311	3-0-2	04	85
3	VI	Communication and Signal Processing	EC312	3-0-2	04	85
4	VII	Sensors and Instrumentation	EC411	3-0-2	04	85
5	VII	Mini Project	EC413	0-0-4	02	70

EC222: ANALOG ELECTRONICS

L	T	P	C
3	0	2	4

1. Course Outcomes:

CO1	Understand the basics of semiconductors and Diodes
CO2	Explain Transistors and MOSFETs.
CO3	Discuss Optoelectronic devices
CO4	Analyse working of Rectifiers, filters, and regulators circuits
CO5	Classify and analyse Amplifiers and Oscillators circuits
CO6	Illustrate OP-AMP circuits and 555 Timer applications.

2. Syllabus

SEMICONDUCTOR DIODES AND APPLICATIONS	**(12 Hours)**
Semiconductor fundamentals: Review of semiconductor physics, p-n junction, diode characteristics and its temperature dependence, transition and diffusion capacitance of p-n junction diodes, breakdown of junctions on the reverse bias, PN diode Application as Rectifiers, clippers, clampers, voltage multipliers, Filter circuits, C, LC and pie filter with circuit Diagram and waveforms, Special Purpose Diode: Zener Diode theory, Construction, Operation with forward and reverse VI characteristics, Zener Voltage Regulator, Schottky diode: construction and application, Varactor Diodes, Light Emitting Diode, Photo diode, LDR, LCD.	
TRANSISTORS AND MOSFETs	**(12 Hours)**
Bipolar Junction Transistors: Transistor Construction, Operation, I/P-O/P characteristics, configurations, limits of Operation, Transistor biasing, Bias stabilization, small-signal analysis. Transistor as a switch. Field-Effect Transistors- Construction and Characteristics of JFETs, Transfer Characteristics, Important Relationships, Depletion-Type MOSFET, Enhancement-Type MOSFET.	
AMPLIFIERS AND OSCILLATORS	**(10 Hours)**
Single Stage transistor amplifier: Graphical demonstration of transistor amplifier, DC and AC equivalent circuits, voltage gain, AC emitter resistance, classification of amplifiers, Amplifier equivalent circuit. Frequency response of amplifiers: Bode plots, gain-bandwidth product, Amplifiers with Negative feedback. Oscillators: positive feedback amplifier, Essentials of transistor oscillators, different types of transistor oscillators: colpitt, Hartley, phase shift, wein bridge oscillators, limitations of RC and LC oscillators, crystal oscillator- construction and working.	
OPERATIONAL AMPLIFIER	**(11 Hours)**
Differential amplifier, block diagram of typical Op-Amp, schematic symbol, the ideal Op-Amp, equivalent circuit of an Op-Amp, Op-Amp Parameters-Input Impedance, Output impedance, input offset voltage, Open Loop Voltage gain, input bias current, slew rate, CMRR, open loop Op-Amp configurations **Application:** Voltage series feedback amplifier, Voltage shunt feedback amplifier, DC and AC amplifiers, summing, scaling and averaging amplifiers, voltage to current converter, integrator, differentiator, basic comparator, zero-crossing detector, Schmitt trigger	

PRACTICAL WILL BE BASED ON THE COVERAGE OF THE ABOVE TOPICS SEPARATELY	(30 Hours)
(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3. List of Practical

1	To study the Active/Passive Components and Various Instruments
2	To study and plot the volt-ampere characteristics of pn junction diode in Forward and Reverse bias and obtain the cut-in voltage.
3	To study and design Half Wave Rectifier with and without filter and calculate its ripple factors.
4	To study and design Zener diode based voltage regulator and calculate the line and load regulation.
5	To study and design Full Wave Rectifier with and without filter and calculate its ripple factors.
6	To study and plot the I/P and O/P characteristics of BJT / MOSFET
7	To study and design single RC coupled Amplifier using BJT/MOSFET.
8	To study and design Inverting & Non Inverting Amplifier using Op-Amp
9	To study and design Adder/Subtractor using Op-Amp
10	To study and Design RC Phase Shift Oscillator using BJT/op-amp
11	To study and Design square wave generator using op-amp
12	Minor Project

4. Bools Recommended

1	Electronic Devices and Circuit Theory, by Boylestad / Nashelsky, 11th Edition, 2015.
2	Electronics Principles by Malvino, Mc. Graw Hill, Ninth edition. 2021.
3	Electronic Devices and Circuits, by Anil K. Maini, Varsha Agrawal, Wiley, 2009.
4	Electronics Analog and Digital by I. J. Nagrath, PHI Learning Pvt. Ltd., 2013 Edition.
5	Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Learning Pvt. Ltd., Fourth Edition, 2015.

EC311: DIGITAL ELECTRONICS AND MICROCONTROLLERS

L	T	P	C
3	0	2	4

1. Course Outcomes:

CO1	Apply Boolean algebra to understand binary logic and logic circuits.
CO2	Formulate combinational logic problems and solve using truth table. Optimize using K-map and other equivalent techniques
CO3	Design and realize synchronous Sequential logic circuits
CO4	Understand operation counters, registers and memory
CO5	Investigate organization of computer and describe internal architecture of 8051microcontroller
CO6	Develop Assembly programs of microcontroller to implement algorithms

2. Syllabus

BOOLEAN ALGEBRA AND SIMPLIFICATION	**(06 Hours)**
Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Minterms and Maxterms, Standard Representations of Logic Functions- SoP and PoS Forms, Introduction to K maps, Simplification of Boolean Functions using K-Map.	
COMBINATIONAL LOGIC CIRCUITS	**(09 Hours)**
Full adder and Full subtractor design, Binary Parallel Adder, Carry Look-ahead Adder, Magnitude comparator, BCD adder, Encoder Priority Encoder, Decoder, Multiplexer and De-multiplexer Circuits, Implementation of Boolean Functions using Decoder and Multiplexer, Arithmetic and Logic Units.	
LATCHES AND FLIP-FLOPS	**(08 Hours)**
Cross Coupled SR Flip-Flop Using NAND or NOR Gates, Clocked Flip-flops, D-Types and Toggle Flip-flops, Truth Tables and Excitation Tables for Flip-flop. Master Slave Configuration, Edge Triggered and Level Triggered Flip-flop, Flip-flop with Preset and Clear.	
SEQUENTIAL LOGIC CIRCUIT	**(08 Hours)**
Introduction to State Machine, Mealy and Moore Model, State Machine Notation, State Diagram, State Table, Flip flop excitation table, Design procedure of clocked sequential circuits. Registers with parallel load, Shift Left and Shift Right Register, Serial-in-Parallel-Out (SIPO) and Parallel-In-Serial-Out (PISO), Ripple counter, and synchronous counters.	
INTRODUCTION TO MICROCONTROLLERS	**(06 Hours)**
Internal Organization of Computer, Buses of the computing system, CPU with RAM and ROM, ALU), Introduction to 8051 8-bit microcontroller, Internal architecture of 8051, and Addressing modes. A brief overview of I/O Ports, Timers, and Serial communication. Advanced microcontrollers.	
8051 ASSEMBLY LANGUAGE PROGRAMMING	**(08 Hours)**
8051 data types and registers, Instructions for moving data, Arithmetic and Logical instructions Jump and CALL instructions, and Example programs in assembly language.	
PRACTICAL WILL BE BASED ON THE COVERAGE OF THE ABOVE TOPICS SEPARATELY	**(30 Hours)**

(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)

3. List of Practical

1	Verify truth table of variety of logic gates
2	Flip-flops using NAND/ NOR Gate.
3	Half-Adder/ Half-subtarctor Circuits
4	Full-Adder/ Full-subtarctor Circuits .
5	4-Bit Gray To Binary/ Binary To Gray Code convertor using Select input.
6	RS and D flip flop using NAND gates
7	JK and T flip flops using NAND gates
8	Shift registers using D flip flops
9	4-bit ripple counter
10	Implement mod 5 synchronous counter
(Following 8051 assembly programming PracticalS are to be performed Keil uVision tool)	
11	Move block of Data from source to destination Keil uVision
12	Write assembly code to read data from array and compute sum
13	Develop assembly code to convert BCD to binary.
14	Write assembly code to convert Binary number to BCD

4. Bools Recommended

1	Mano Morris, “Digital Logic and Computer Design”, Pearson Education, 1st Edition, 2016.
2	Anand Kumar, “Fundamentals of Digital Circuits”, PHI, 4th Ed., 2016.
3	Jain R. P. and Anand M. H. S., “Digital Electronics Practices using Integrated Circuits”, TMH, 1st Ed., 2004.
4	K. Ayala, “The 8051 Microcontroller”, Cengage Learning, 3rd Ed., 2009.
5	Muhammad A. Mazidi and Janice G. Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearson, 2nd Ed.,2013.

EC312: COMMUNICATION AND SIGNAL PROCESSING

L	T	P	C
3	0	2	4

1. Course Outcomes:

CO1	Describe the basic knowledge of Communication techniques including analog and digital communication and details of wireless link
CO2	Explain about signal processing aspects involved in analog digital communication with time and frequency domain fundamentals.
CO3	Apply the concepts to the problems of communication techniques for optimizing the performance, may be using signal processing aspects.
CO4	Compare performance analysis of various modulation and coding techniques for a link, case study and problem solving as per given parameters.
CO5	Evaluate various stages of communication link and signal processing performance parameters by experimentation using modern tools/simulators and hardware.
CO6	Design the communication link with optimum parameter selection criteria satisfying given requirements.

2. Syllabus

TRANSMISSION OF SIGNALS	**(06 Hours)**
Fourier Transform Properties and their applications in communication systems, The Exponential Fourier Series, Transmission of some useful functions, Signal Transmission Through a Linear System and Convolution concepts, Ideal versus Practical Filter, Channel as a filter.	
NOISE	**(03 Hours)**
Various Types of Noises: Internal (Shot, Thermal, Agitation, Transit Time) Noise and External Noise, White Noise and Filtered Noise, AWGN Properties.	
ANALOG MODULATION AND DEMODULATION TECHNIQUES	**(10 Hours)**
Modulation, Baseband Vs Carrier Communications, Amplitude modulation: DSB-C And DSB-SC Bandwidth Efficient AM: SSB, Vestigial Sideband (VSB) Transmission, Frequency Division Multiplexing. Frequency modulation: Nonlinear Modulation, Carson's Rule, Bandwidth of Angle Modulated Waves, NBFM and WBFM, Generating FM Waves, Demodulation of FM Signals.	
SAMPLING AND PULSE MODULATION TECHNIQUES	**(08 Hours)**
Sampling theorem, Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Bandlimited Signals, Discrete-Time Processing of Continuous-Time Signals, Continuous the Sampling Processing of Discrete-Time Processing. Sampling and A to D conversion of signals, Quantization techniques—Uniform and Non-uniform, A-law and μ-law, Pulse Code Modulation, Pulse Amplitude Modulation, Pulse Position Modulation, Pulse Width modulation.	
DIGITAL DATA TRANSMISSION AND RECEPTION USING SIGNAL PROCESSING	**(10 Hours)**
Digital Communication System, Line Coding, Pulse Shaping For Optimum Transmission, ISI and ISI-Free transmission, Band-limiting of Rectangular Pulses, Raised Cosine Filtering, Regenerative Repeaters, Matched Filter And Equalizers, Eye Diagrams	
BANDPASS SIGNAL TRANSMISSION-DIGITAL CARRIER SYSTEM	**(08 Hours)**
Representation of Digital Modulated Signal, ASK, PSK, FSK, QAM (MODEMs) and Constellation Diagram, Spectral Characteristics of Digitally Modulated Signals. M-Ary Digital Carrier Modulation.	

PRACTICAL WILL BE BASED ON THE COVERAGE OF THE ABOVE TOPICS SEPARATELY	**(30 Hours)**
(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3. List of Practical

1	AM with Performance Analysis under Channel Effects.
2	FM with Performance Analysis under Channel Effects.
3	Sampling theorem
4	FDM and TDM
5	Simulation of ASK, FSK and PSK with study of constellation diagram.
6	Simulation of Line Coding Techniques.
7	Simulation and Implement the Effect of Raised Cosine Filter and pulse shaping.
8	Simulation of Eye Diagram.
9	Source Coding Techniques
10	Error Control Coding Techniques.

4. Bools Recommended

1	Lathi B.P. and Ding Zhu, "Modern Digital And Analog Communication Systems", 5th Ed., Oxford University Press, 2019.
2	John G. Proakis and Masoud Salehi, “Digital Communications”, 5th Ed., McGraw-Hill, 2014.
3	Bhattacharya Amitabh, "Digital Communication", 1st Ed., Tata McGraw-Hill, 2006.
4	Carlson Bruce A., Paul B Crilly “Communication Systems- An Introduction to Signal and Noise in Electrical Communication”, 5th Ed., McGraw-Hill, 2011.
5	Taub Herbert, Donald Schilling, Goutam Saha “Principal of Communication Systems”, 4th Ed., Tata McGraw-Hill, 2013.

EC411: SENSORS & INSTRUMENTATION

L	T	P	C
3	0	2	4

1. Course Outcomes:

CO1	Explain the different types of sensors, signal conditioning and data acquisition methods with working principle
CO2	Apply the concepts of sensors and instrumentation for various applications
CO3	Analyze different sensors and signal conditioning methods for various real time applications.
CO4	Evaluate the applications of sensors and data acquisition methods in instrumentation.
CO5	Design the sensors systems for different applications

2. Syllabus

CONCEPTS AND TERMINOLOGY	**(04 Hours)**
Definition of Sensor, Transducer And Actuator, Transducer/Sensor Classification, Criteria to Choose a Sensor, Sensor Classification, Measurement Systems, General Input-Output Configuration, Static and Dynamic Characteristics of Sensors.	
PASSIVE SENSORS	**(10 Hours)**
Potentiometers, Strain Gages, Resistive Temperature Detectors (RTDs), Thermistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas Sensors, Capacitive Sensors, Inductive Sensors, Hall effect Sensors, Optical Sensors, Acoustic Sensors, SAW Sensors	
SELF-GENERATING SENSORS	**(08 Hours)**
Principle of operation, construction, theory, advantages and disadvantages and applications of following transducers: Thermocouple, Piezo-electric transducer, Pyroelectric transducers, Photo-voltaic transducer, Electrochemical transducer.	
SIGNAL CONDITIONING FOR SENSORS	**(09 Hours)**
Voltage Dividers, Wheatstone Bridge, Sensor bridge calibration and balance, Differential And Instrumentation Amplifiers, Interference, Specific Signal Conditioners for Sensors, Telemetry system.	
DATA ACQUISITION METHODS	**(09 Hours)**
Basic block diagram, Analog and Digital IO, Timers, Type of ADC: Successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.	
ADVANCEMENTS IN SENSORS AND INSTRUMENTATION	**(05 Hours)**
Sensors For Robotics, Sensors Used In Smartphones, Sensors Used In Smart City, MEMS, Nano Sensors, Smart Sensors, Integrated Sensors, IoT Applications, Study of Sensor IC/Module datasheet.	
PRACTICAL WILL BE BASED ON THE COVERAGE OF THE ABOVE TOPICS SEPARATELY	**(30 Hours)**
(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3. List of Practical

1	To study the characteristics of the Potentiometer.
2	To study the characteristics of Variable Capacitor
3	To study the characteristics of Strain Gauge.
4	To study the characteristics of Light Dependent Resistor.
5	To study the characteristics of LVDT
6	To study the characteristics of the Resistance Temperature Detector
7	To study the characteristics of a Thermistor.
8	To study the characteristics of Thermocouples.
9	Design and Implement a Simple R to V, V to I, and V to V Convertor given specifications.
10	Bridge Linearity technique using Op-AMP.
11	Instrumentation amplifier using Feedback.
12	DATA acquisition using DAQ card.

4. Bools Recommended

1	Arun K. Ghosh, Introduction to Measurements and Instrumentation, PHI 4th Edition 2012.
2	Arun K. Ghosh, Introduction to Transducers, PHI, 2014.
3	D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
4	S. Vijayachitra, Transducers Engineering, PHI 2016.
5	S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.