Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous),

Shivajinagar, Pune - 5

PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1101
Course Name: Analog Circuit Design

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End- Sem: 50 Marks**

Prerequisite Courses:

- Fundamental working principle of electronic Devices.
- Students must have knowledge of frequency response of devices.
- Knowledge of feedback concepts.

Course Objectives:

- To learn the characteristics and working of Electronic devices.
- To study the wide-band and narrowband amplifiers using BJT.
- To develop skills in analysis and design of analog circuits.
- To study and design oscillator circuits.

Course Outcomes:

On completion of the course, student will be able to–

- Understand operation of p-n junction diode with its small and large signal models with its terminal characteristics and derivation of diode equation.
- Understand physical structure of Bipolar junction transistor with operation in various modes of operation with derivation of collector current equation.
- Understand physical structure of JFET and MOSFET with operation, and both T type and π type of models.
- Understand the frequency response of BJT amplifiers. Understand the functioning of transistor in low and high frequency regions.
- Understand the feedback concepts and construct feedback amplifiers and oscillators. Also summarizes its performance parameters.

Course Contents:

Chapter 1	Basic Semiconductor Devices	lectures
	Diode: Practical diode characteristics (static and dynamic resistance), temperature effects, switching characteristics, diode breakdown, diode applications in wave shaping circuits. **BJT**: construction, biasing and operation, CC, CB and CB configurations. **UJT**: construction, working principle, I-V characteristics, Specifications parameters of Uni-Junction Transistor (UJT). **JFET**: Construction, types and operation, characteristics, parameters of JFET, comparison of BJT and JFET, JFET amplifiers. **MOSFET**: depletion & enhancement, biasing of MOSFET, applications.	15

Chapter 2	Signal Analysis and frequency response	lectures
	Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of RS and RL on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits. **Small Signal Analysis of FETs:** Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of RSIG and RL on CS Amplifier; Source Follower and Cascaded System. **High Frequency Response of FETs and BJTs:** High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier. Frequency response of multistage amplifiers, different coupling schemes and gain of multistage amplifiers	15
Chapter 3	Tuned Amplifier and Oscillators	lectures
	Tuned Amplifier: Single stage tuned amplifier design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large-signal tuned amplifier. **Oscillators:** design and analysis of LC and RC oscillators, Hartley oscillator, Colpitt's oscillator, Miller oscillator, phase shift oscillator, Wein-bridge oscillator, crystal oscillator, Bubba oscillator and their applications.	15
Chapter 4	Operational Amplifiers and their Applications	lectures
	Practical consideration in op-amp based circuit design, op-amp parameters: DC and low-frequency parameters, their significance in the design of op-amp, closed-loop stability analysis and frequency compensation. **Applications:** Inverting and non-inverting amplifiers with design aspects, bridge and instrumentation amplifier, integrator, differentiator, V to F, F to V and Phase Locked Loop (PLL). Active filters: LPF, HPF, BPF and BRF, Butterworth filters (design of first and higher orders).	15

Text / Reference Books:

1) **Electronic Devices and Circuit Theory,** *by Robert Boylestead, Louis Nashelsky, PHI.*
2) **Grob's Basic Electronics,** *by Mitchel E. Schultz 11e McGraw Hill*
3) **Design with Operational Amplifiers and Linear IC,** *by Sergio Franco, 3rd Edn, TMH.*
4) **Electronic Principles,** *by Malvino and Bates, McGraw Hill.*
5) **Operational Amplifier,** *by G.B. Clayton, Elsevier Sci. Tech.*
6) **Microelectronic Circuits, Analysis and Design,** *by Mohammad H. Rashid, PWS Publishing*
7) **Microelectronic Circuit,** *by Sedra Smith, 6e oxford university press.*

MOOC / NPTEL Courses:

1. NPTEL Course "Analog Electronic Circuits"
   https://nptel.ac.in/courses/108/105/108105158/
2. NPTEL Course on "Analog Circuits"
   https://nptel.ac.in/courses/108/101/108101094/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1102
Course Name: Advanced Digital System designing using Verilog

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Students need a thorough understanding of Boolean algebra, combinational and sequential digital circuits and number systems (binary, hexadecimal).

Course Objectives:

- To study sequential and combinational logic design techniques
- To learn PLD, CPLD, FPGA and their applications.
- The ability to code and simulate any digital function in Verilog HDL.
- Know the difference between synthesizable and non-synthesizable code.
- Understand library modeling, behavioral code and the differences between then.
- Understand the differences between simulator algorithms.
- Learn good coding techniques per current industrial practices.
- Understand logic verification using Verilog simulation.

Course Outcomes:

On completion of the course, student will be able to–

- Design combinational circuits and sequential circuits using discrete components.
- Understand PLDs and digital memories.
- Acquire ability to design systems which include hardware and/or software components within realistic constraints such as cost, feasibility to manufacture , safety and environmental concerns.
- Acquire an ability to identify, formulate, and solve electrical and computer engineering problems.
- Communicate effectively through written reports and oral presentations.
- Use modern engineering techniques for analysis and design.
- Analyze and design complex devices and/or systems containing hardware and/or software components.

Course Contents:

Chapter 1	Digital Circuit Design	17 lectures
	Combinational Logic Design Review of Boolean identities and its use to minimize Boolean expressions. Minimization of Boolean expressions using Karnaugh map (up to 4 variables). Arithmetic Circuits: Half-Adder, Full adder, Half-Subtractor, Full-Subtractor, BCD Adder, Arithmetic Logic Unit (ALU). Multipliers, Demultiplexers, Encoders, Decoders, Magnitude Comparator	

	Sequential Logic Design Sequential Circuits, Types of Sequential Circuits: Synchronous Circuit, Asynchronous Circuit. Flip Flop Circuit: R-S, J-K, T and D Flip-Flop. Level-Triggered and Edge-Triggered Flip-Flops, Flip-Flop Timing Parameters, Flip-Flop Applications. Counters and Registers: Asynchronous Counter, Synchronous Counter, Cascading Counters, Designing Counters with Arbitrary Sequences. Shift Register: Serial-In Serial-Out Shift Register, Serial-In Parallel-Out Shift Register, Parallel-In Serial-Out Shift Register, Parallel-In Parallel-Out Shift, Bidirectional Shift Register, Universal Shift Register.	
Chapter 2	PLDs, Memories	13 lectures
	Need of PLD, architecture of simple PLD (SPLD)-PAL, PLA, Complex Programmable Logic Device (CPLD) and Field Programmable Logic Devices (FPGA) CPLD/FPGA based system design applications: typical combinational and sequential system implementation, estimation of uses of blocks, links, LUTs, etc. Memories: types, data storage principle, control inputs, and timings, applications, Random Access Memories (RAM), Static Ram (SRAM), standard architecture, address decoders, timings, Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings, role of memories in PLD.	
Chapter 3	Introduction to Verilog	15 lectures
	Overview of Digital Design with Verilog HDL. Basic Concepts: Synthesis, Data types, Constants, Parameters. Continuous Assignment Statement, Procedural Assignment Statement, Logical Operators, Arithmetic Operators, Relational Operators, Equality Operators, Shift Operators, Vector Operators. Conditional Expression, Always Statement, If Statement, Case Statement, Loop Statement, Modeling Flip-flops, Blocking and Non-blocking assignments. Tasks and Functions, Gate level modeling.	
Chapter 4	Verilog Modeling and Verilog Verifications	15 lectures
	Verilog Modeling Modeling: Combinational Logic, Sequential Logics, Memory, Finite State Machine, Universal Shift register, ALU, Counter, Parameterized Adder, Comparator, Decoder, Multiplexer. Model Optimizations: Resource Allocation, Common Subexpressions, Moving Code, Common Factoring, Commutativity and Associativity, Flip-Flop and Latch optimizations, Design Size. **Verilog Verifications** A Test Bench, Delay in Assignment Statements Unconnected Ports, Missing Latches, More on Delays, Event List, Synthesis Directives, Variable Asynchronous Preset Blocking and Non-blocking assignments: Combinational Logics, Sequential Logics.	

Text / Reference Books:

1) Digital Design; Principles Practices.by Wakerly, PHI.
2) Modern Digital Electronics,by R.P Jain McGraw Hill.
3) Digital Systems; Principles and Applications.by Tocci, Pearson Education.
4) Digital Logic and Computer Design.by Morris Mano, PHI.
5) Digital Electronics Principles, Devices and Applications. by Anil K. Maini.
6) Verilog HDL Synthesis a Practical Primer,by J. Bhasker, Star Galaxy Publishing.
7) Verilog HDL; A Guide to Digital Design and Synthesis,by Samir Palnitkar, Pearson Education, 2nd edition, 2003.
8) Verilog HDL synthesis; A Practical Primer,by J. Bhaskar, Star Galaxy Publishing, 1998.
9) Digital System Design with VERILOG Design,by Stephen Brown, ZvonkoVranesic, TMH, 2nd edition, 2007.

MOOC / NPTEL Courses:

1. NPTEL Course on **"Digital Circuits"**
https://nptel.ac.in/courses/%20108105113

2. NPTEL Course on **"Digital Circuits & Systems"**
https://nptel.ac.in/courses/117/106/117106086/

3. NPTEL Course on **"Digital Electronic Circuits"**
https://nptel.ac.in/courses/108/105/108105132/

4. NPTEL Course on Hardware modeling using verilog
https://archive.nptel.ac.in/courses/106/105/106105165/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1103
Course Name: Electronic Practical Lab 1

Teaching Scheme: PH: 8 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

A. Practical based on Advance Analog Circuit Design.

1. To determine and plot the characteristics of light emitting diodes in forward bias region and compare between different color diodes.
2. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
3. To study transistor dc biasing circuits.
4. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain bandwidth product from its frequency response.
5. Design, setup and plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth.
6. Tuned amplifier small signal / large signal for IF.
7. Transistor based microphone amplifier.
8. Design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation. a) Hartley Oscillator (b) Colpitts Oscillator.
9. Common Emitter / Common Base input-output Characteristics
10. Plot the transfer and drain characteristics of a JFET and calculate its drain resistance, mutual conductance and amplification factor.
11. Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
12. Design, implementation and study parameters of 78xx regulated power supplies.
13. Study of V-I characteristics of SCR, TRIAC and DIAC.
14. Study Conductivity measurement using four probe method
15. Study of Hall effect.

B. **Practical based on Operational amplifier**

1. Study the characteristics of negative feedback amplifier a. A Unity gain amplifier b. A Non-inverting amplifier c. An Inverting Amplifier.
2. Plot frequency response of AC coupled amplifier using op amp 741 and study the effect of negative feedback on the bandwidth and gain of the amplifier.
3. To study Astable, Monostable Multivibrators And Schmitt Trigger Using Op-Amp
4. Design of an Instrumentation amplifier

5. Design and construct a rectangular waveform generator (Op-Amp relaxation oscillator) for given frequency.
6. Design of LPF, HPF, BPF and Band Reject Filters.
7. Voltage controlled current source / sink and current mirror
8. To build and test current telemetry (4 to 20 mA)
9. Study of 8-bit monolithic Analog to digital converter IC
10. Study of R - 2R ladder network DAC and DAC IC1408
11. PLL characteristics and demonstrate any one application (IC565/CD4046)
12. V to F and F to V using commercially available IC

C. Practical Based On Network Analysis

1. Verification of KVL and KCL theorem
2. Verification of Thevenin's Theorem and maximum power transfer theorem for DC circuit.
3. Characteristics of Series and Parallel Resonant Circuits.
4. Step and frequency response of series LCR circuits.
5. Determination of circuit parameters: Open Circuit and Short Circuit parameters.
6. Study of z parameter of simple network

D. Practical based Instrumentation and measurement system.

1. Study and calibration of Pt – 100 as a temperature sensor and its signal conditioning circuit
2. Study of Strain gauge as load sensor and its signal conditioning circuit
3. RPM measurement using various methods
4. Design build and test IR transmitter and receiver (TSOP1738 or similar) for object Detection
5. Design build and test rms to dc converter for voltage measurement of ac signal
6. Study of linear displacement transducer and its signal conditioning circuit
7. Study of optical sensors: LDR and photo diode and their signal conditioning circuit.

E Digital circuit Simulation/ implementation using verilog HDL Lab

1. Design 8 to 1-line MUX/ 1 to 8 DEMUX Use gate level, data flow, structural, behavioral style of modeling.
2. Design 2-4, 3-8 decoder (using Gate level, Structural, Behavioral modeling) and BCD to Seven Segment Decoder (using Behavioral modeling).
3. Arithmetic circuits: Half adder, Full adder (using Gate level, Data flow modeling) and Parallel adder using structural modeling.
4. Design
   i) 2-bit magnitude comparator using gate level modeling.
   ii) 4-bit magnitude comparator using structural modeling.
5. Design of flip-flops using: RS, D and T using behavioral modeling and Design of Counter using T flip-flops (Use Structural modeling): Asynchronous counter and Asynchronous up/down counter.
6. Design the following

   Up-down bit binary counter (minimum 4-bit) using behavioral modeling.

   Shift register using D flip flops (Structural).

   Shift register using behavioral modeling.

Code converter – binary to gray, gray to binary using data flow modeling.

Encoder- 8 to 3 encoder, priority encoder using behavioral modeling.

7. Four bit ALU design (structural modeling).
8. Keyboard Scanning.
9. Designing of Traffic Light Controller.
10. LCD controller.
11. Practical based on state machine (Stepper sequence generator/Vending Machine/ Washing Machine).

Practical based on Simulation:

1. Study of D.C. analysis network circuits using Multisim.
2. Study of transient and AC analysis: Rectifiers, clippers and Clamper.
3. Study of Frequency response of single stage and multistage RC coupled amplifier.
4. Design and simulate BJT bias circuit and compare the results.
5. Design and simulate JEET/MOSFET bias circuit and compare the results.
6. Design and simulate JFET/MOSFET common-emitter circuit and compare D.C. and A.C. performance
7. Study of Voltage and Current Time base circuits (Bootstrap generator)
8. Study of Double and Stagger tuned Amplifiers
9. Phase shift, Hartley, Colpitt and Wien bridge oscillators using transistors (any two).

Virtual LAB Links:

Basic Electronics Virtual Lab:

http://vlabs.iitkgp.ernet.in/be/

Digital Electronics Circuits Lab:

http://vlabs.iitkgp.ernet.in/dec/

Digital Logic Design Lab:

http://cse15-iiith.vlabs.ac.in/

Hybrid Electronics:

http://he-coep.vlabs.ac.in/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1104
Course Name: Electronic Instrumentation System

Teaching Scheme: TH: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 25 Marks **End-Sem: 25 Marks**

Prerequisite Courses:

- Basics of sensing elements, bridges and basic electronics, sensors and transducer

Course Objectives:

- To understand the configurations and functional descriptions of measuring instruments.
- To understand the basic performance characteristics of instruments.
- To understand the working principles of various types of sensors and transducers and their use in measuring systems.
- To study the techniques involved in various types of instruments.
- To understand the relevance of electronics with other disciplines.

Course Outcomes:

On completion of the course, student will be able to–

- Understand the basic op-amp circuit building blocks and understand their limitations due to non-ideal parameters of the op-amp
- Understand the use of op-amp in saturation as a comparator, zero crossing detector, astable multivibrators and monostable multivibrator
- Understand the principle of operation of generalized measurement systems and different sources of errors in measurements.
- Understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of transducer /sensors.
- Understand fundamentals of fluid flow and their applications to flow through pipes and hydraulic machines.
- Understand various techniques used for measuring parameters of temperature measurement in Industries.
- Understand the principles of industrial processes & process in pressure measurement
- Understand the different types of force & level measurements adopted in industrial
- Understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of transducer /sensors.

Course Contents:

Chapter 1	Introduction to Measurement and Measurement Systems	18 lectures
	Definition and significance of measurement, classification of instruments and types of measurement applications, elements of an instrument / measurement system, active and passive transducers, analog and digital modes of operation, null and deflection methods, input-output configuration of instruments and measurement systems, methods of	

	correction of instruments and measurement systems. **Generalized performance characteristics and errors of instruments:** static and dynamics characteristics of measurement system, Errors in measurement: Types of Errors - gross, systematic, environmental errors, systemic errors, computational error, personal error etc.	
Chapter 2	Measurement instruments	10 lectures
	Measurement techniques for R, L, C, voltage, current, power, energy, frequency and phase. Digital multimeter, CRO. Digital storage oscilloscope: specifications, performance parameters and applications. Review of signal sources, synthesized signal source and arbitrary waveform generator. Review of instrumentation for signal analysis - digital frequency meter and spectrum analyzer.	

Text / Reference Books:

1) Measurement Systems, Applications and Design, by Ernest O. Doeblin and Dhanesh N. Manik, 5th Edition, Tata McGraw Hill.
2) A Course in Electrical and Electronic Measurements and Instrumentation, by A.K. Sawhney, Dhanpat Rai & Co.
3) Electronic Instrumentation, by Kalsi, TMH.
4) Modern Electronic Instrumentation and Measurements Techniques, by Cooper and Helfrick, PHI.

MOOC / NPTEL Courses:

1. NPTEL Course on **"Electrical Measurements & Electronics Instruments"**

Link of the Course: https://nptel.ac.in/courses/108/105/108105153/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1201
Course Name: Network circuits analysis and synthesis (Elective)

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:
- Fundamental Mathematical Tools.
- Fundamentals of Electrical Engineering and Mathematics

Course Objectives:
- To learn the concept of mathematical modeling of simple electrical circuits.
- To study mathematical tools and techniques for network analysis.

Course Outcomes:

On completion of the course, student will be able to–
- Know the concepts of Modeling and its types.
- Know the concepts of Laplace Transforms and its application to solve Differential Equations.
- To understand the basic concepts of AC & DC circuits.

Course Contents:

Chapter 1	Network Analysis	lectures
	Network Topology (nodes, tree, graph, branch, mesh, and loop) Network Theorems and Applications to DC and AC Circuits: Thevenin's, Norton's, superposition, maximum power transfer theorems Mesh, loop and nodal analysis of circuits, T and π networks, Attenuators, equalizers, series and shunt equalizers.	15
Chapter 2	Mathematical Modeling, Systems and Signals	
	Mathematical modeling Concept of modeling, types, mathematical modeling using differential equations, transfer function. Signal flow method, state variable method with simple examples, analogous physical and electrical quantities. **Signals** Periodic, a periodic, Continuous Time (CT) and Discrete Time (DT), special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase).	15
Chapter 3	Laplace Transform Mathematical Tools for Circuit Analysis	lectures
	Laplace Transform Definition, LT of standard electronic signals, inverse LT, methods of ILT (partial fraction method), properties of LT (shifting, linear, scaling), initial and final value theorem, LT of derivatives and integrals, solution of DE using LT, concept of Transient and steady state response.	15

Chapter 4	Laplace Transform Mathematical Tools for Circuit Analysis	lectures
	Laplace transformation of electrical circuits, two port network functions, time and frequency domain response of systems using transfer function, poles and zeros of transfer function and their significance, applications to simple passive filters such as Low Pass (LP), High Pass (HP), Butterworth filters, stability criterion, Routh-Hurwitz criterion, synthesis of transfer function using poles and zeros.	15

Text / Reference Books:

1) Advanced Engineering Mathematics, by E. Kreyzig, John Wiley and Sons.
2) Signals, Systems, And transforms, 4ed, by Charles L. Phillips, John M. Parr, Pearson Prentice Hall
3) Network Analysis, by G. K. Mittal, Khanna Publication.
4) Fundamentals of Signals and Systems, by Benoit Boulet, Charles River Media
5) Circuits and Networks Analysis and Synthesis, by A. Sudhakar, Shyam Mohan and Pilli, TMH.
6) Digital Signal Processing, by S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill.
7) Network Analysis, by M. E. Van Valkenberg, PHI.
8) Network and Systems, by Roy Choudhary, Wiley Eastern.

MOOC / NPTEL Courses:

1. NPTEL Course on " Network Analysis "
Link of the course: https://archive.nptel.ac.in/courses/108/105/108105159/
2. NPTEL Course on "Basic Electric Circuits"
Link of the course: https://archive.nptel.ac.in/courses/108/104/108104139/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP1202

Course Name: Sensors in Automation (Elective)

Teaching Scheme: TH: 4Hours/Week — Credit: 04

Examination Scheme: CIA: 50 Marks — End-Sem: 50 Marks

Prerequisite Courses:

- Basics of Analog Circuits.
- Basics of Digital Circuits.

Course Objectives: To make the students understand about:

- Concept of Sensors/Transducers and their Static and Dynamic Characteristics.
- Sensors used in Industry for Temperature and Humidity Measurement.
- Sensors used for Sensors used for Force, Pressure, Stress and Flow measurements.
- Sensors used for Displacement and Level Measurement.
- Applications of Image and Biosensors.
- Role of Sensors/Transducers in IoT applications.

Course Outcomes:

On completion of the course, student will be able to-

- Understand the Concepts of Sensors/Transducers, classify and evaluate static and Dynamic Characteristics of Measurement Systems.
- Choose the proper sensor comparing different standards and guidelines for measurements of
- Temperature and Humidity.
- Choose the proper sensor comparing different standards and guidelines for measurements of Force, Pressure, Stress and Flow
- Choose the proper sensor comparing different standards and guidelines for measurements of Displacement, Vibration, Acceleration and Level
- Explore sensors to profound areas like environmental, Agricultural and bio-medical equipment and sustainability.
- Explore IoT based applications of Sensors and Transducers.

Course Contents:

Unit 1	**Sensors for Temperature and Humidity Measurement**	Lectures
	Temperature Measurement: Units of Temperature Measurement / Temp Measurement Scales; Celsius Scale, Fahrenheit Scale, Kelvin Scale, Rankine Scale-Unit Conversions Broad Classification of Temperature Transducers, RTD (e.g.PT-100), Thermocouple, Thermistors, Optical Fiber Sensors. (Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning (e.g Instrumentation Amplifier (with AD-620). **DC bridge:** Wheatstone bridges, **AC Bridge:** Wein Bridge, Schering Bridge, Signal Conditioning: 2 Wire, 3-Wire and 4-Wire Compensation. **IR Temperature Sensor:** MLX90614 ESF Non-Contact Human Body Infrared Temperature Measurement Module.	15

	Smart temperature and solid state sensors: LM35, AD590 (Only for real time application/implementation in project based learning) **Humidity:** Hygrometer, Soil Humidity Sensor, Soil Hygrometer (DHT11, TI HDC1050)	
Unit 2	**Sensors for Force, Pressure, Stress and Flow**	Lectures
	(Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning) • **Pressure scales:** Newton, Bar, Pascal, PSI -Unit Conversions • Absolute, Gauge and Vacuum Pressure **Classification of Pressure sensors:** Strain gauge (Load Cell using Strain gauge), Piezoelectric Transducer, Solid State Pressure Sensors (**IC's like GY-63 MS5611-01BA03 to be discussed**) Differential Pressure Transducer flow measurement **(only Mention of basic Principle of working, Bernoulli's theorem)**, Orifice, Venturi, Nozzle flow meter **(only Descriptive)**, Pneumatic sensors (bellows, diaphragm), Ultrasonic and Hall effect Sensors for flow Measurement **Solid State Flow Sensors: YF-S201, E8FC-25D**, Fiber-Optic Sensors.	15
Unit 3	**Sensors for Displacement, Vibration, Acceleration and Level**	Lectures
	(Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning) **Classification of Displacement Sensors:** Potentiometer, Strain-gauged element, Capacitive element, Differential transformers, Eddy current proximity sensors, Inductive and Capacitive Proximity switch, Optical encoders. Pneumatic sensors (**Bellows, Diaphragm**), Hall effect sensors, Accelerometer, Gyroscope and Magnetometer (**ADXL335/345**), Electro-Optical Sensors, Position Encoders.	10
Unit 4	**Sensors in Environmental Studies, Bio Sensors**	Lectures
	Charge-Coupled and CMOS Image Sensors, Biosensors Resonant mirror, electrochemical, surface Plasmon resonance, Light addressable Potentio-Metric., Ph Measurement, CMOS MQ-2 Smoke LPG Butane Hydrogen Gas Sensor Detector Module **(MQ-3 Alcohol Detector Gas Sensor Module MQ 135 Air Quality / Gas Detector Sensor Module for Arduino Data Sheet MLX90614 non-contact temperature sensor)**, Camera Sensor Ultrasonic proximity, Colour Sensors, Light Sensors Like Light Dependent Resistance(LDR), Photo Diode, Photo Transistors, RFID sensors, e.g. EM18 module, Applications RFID Sensors, MEMS and NEMS sensors	10
Unit 5	**Latest trends in Sensors Applications**	Lectures
	Basic Concept of Data Acquisition Systems (Block Diagram Understanding), Basic Concept of IoT, Sensor Interface in IoT systems. **Case Study 1**: IoT based Agriculture/Greenhouse systems.(Block Diagram) (**Mention of Optical Sensors, Electro-Chemical Sensors, Mechanical Sensors Dielectric Soil Moisture Sensors, Air Flow Sensors may be considered)** **Case Study 2**: IoT based Healthcare Systems.(Block Diagram) (**Mention of ECG Module, Temperature, ,Humidity, Accelerometer, Oxygen Level, Heart Rate sensors**) **Case Study 3**: IoT based Automobile Sector (Engine Management System)	10

	(**Mention of Fuel Level, Ignition, Exhaust Sensors**)	

Text / Reference Books:

1) Electrical and Electronics Measurements and Instrumentation, by Sawhney A. K , Dhanpat Rai & Sons, 4th Edition, 1994.
2) Sensors and Transducers, by D. Patranabis, Prentice Hall India Learning Private Limited.
3) Instrument Engineers Handbook Process Control, by Liptak, Elsevier exclusive
4) Instrumentation and Sensors Handbook,by John G. Webster,CRC Press.

MOOC / NPTEL Courses:

NPTEL Course on "Sensors and Actuators"

Link of the course: https://nptel.ac.in/courses/108/108/108108147/

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PG First Year of M.Sc. Electronic Science

(2023 Course under NEP 2020)

Course Code:

Course Name: Research Methodology

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End- Sem: 50 Marks**

Prerequisite Courses:

- Basic knowledge of what is Research.
- Research areas in Electronic Science
- Read atleast two research papers from reputed journal.

Course Objectives:

- To impart knowledge and skills required for research methodology
- To understand problem formulation , analysis and solutions
- To learn patent drafting and understand patent filing process.

Course Outcomes:

On completion of the course, student will be able to–

- Understand some basic concepts of research and its methodology
- Explore appropriate research topics in the field of study
- Select and define appropriate research problem and parameters
- Prepare a project proposal (to undertake a project)
- Organize and conduct research (advanced project) in a more appropriate manner.
- Write a research proposal (grants) and write a research report/ thesis
- Understand Patent Drafting and filling patents.

Course Contents:

Chapter 1	**Foundation of Research**	**lectures**
	Objectives & Motivation of Research,Meaning, Need(Utility). Concept of theory, empiricism, deductive and inductive theory. **Characteristics of scientific method** - understanding the language of research - Concept, Construct, definition, Variable. Research Process, Problem Identification & Formulation	10
Chapter 2	**Literature Search**	**lectures**
	Importance of Literature survey, Sources of Information,selection of research topic (case study based), laboratory records maintenance . Safety in Laboratories, Ethical considerations, effective verbal and nonverbal communication, field data collection, safety in field.	10
Chapter 3	**Research Design**	**lectures**
	Concept and Importance in Research, Exploratory Research Design - Concept, Types and uses,Experimental Design - Concept of Independent & Dependent variables.	

	Descriptive Research Design - concept, types and uses. **Statistical analysis and its significance:** Exploratory and confirmatory research, Planned and ad-hoc methods of data collection, Non-response and methods of recovering the missing response, Various softwares used for statistical analysis. A Case study module with Data and application of Statistical tools : Error and noise analysis, curve fitting. .	15
Chapter 4	**Intellectual Property Rights (IPR) & Writing research paper and/or thesis**	**lectures**
	Nature of Intellectual Property: patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development. Role of WIPO and WTO in IPR establishments. Right of Property, Common rules of IPR practices, Types and features of IPR Agreement, Trademark, functions of UNESCO in IPR maintenance. Making a presentation, writing a research proposal, and patents in Science, technology.	13
Chapter 5	**Patent Rights (PR)**	**lectures**
	Patent Rights: Scope of patent Rights, Licensing and Transfer of Technology. Patent information and Databases. Geographical Indications. **New Developments in IPR:** Administation of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs Licences, Licensing of related patents, patent agents, Registration of Patent Agents.	12

Text / Reference Books:

1) Research Methodology - C. R. Kothari
2) Research Methodology : An Introduction - Stuart Melville and Wayne
3) Practical Research Methods - Catherine Dawson
4) Leedy, P. D. and Ormrod, J. E., 2004 Practical Research: Planning and Design, Prentice Hall.
5) Satarkar, S. V., 2000. Intellectual property rights and Copy right. Ess Ess
6) Catherine J.Donald," Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets",Entrepreneur Press, 2007
7) Ranjit Kumar," Research Methodology: A Step by Step Guide for beginners" 2nd edition, 2010.
8) Laura R. Ford, " The Intellectual property of Nations: Sociological and Historical perspectives on a Modern Legal Institution paperback-202.1

MOOC / NPTEL Courses:

NPTEL Course on "Research Methodology"

Link of the course: https://nptel.ac.in/courses/127106227

NPTEL Course on "Introduction to Research"

Link of the course: https://archive.nptel.ac.in/courses/121/106/121106007/

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous),

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2101

Course Name: Advanced Microcontroller and its application

Teaching Scheme: TH: 4Hours/Week — Credit: 04

Examination Scheme: CIA: 50 Marks — End-Sem: 50 Marks

Prerequisite Courses:

- Basics of Analog Circuits.
- Basics of Digital Circuits.
- C Programming.

Course Objectives:

- To understand the basics of embedded system.
- To understand the architecture and interfacing of 8-bit microcontrollers.
- To learn software techniques to embed codes in to the systems.
- To learn communication standards and protocols.

Course Outcomes:

On completion of the course, student will be able to-

- Design embedded systems.
- Write drivers and firmware to drive electronic hardware.
- Troubleshoot and debug embedded products.

Course Contents:

Unit 1	**Introduction to Advanced Microcontrollers**	lectures
	Architectural features of different types of architectures used in Microcontrollers, like Van Neumann, Harvard, CISC, RISC, SISC architectures. General applications of Micro-controllers	05
Unit 2	**PIC 18F XXXX Microcontroller Architecture**	lectures
	PIC microcontroller Overview, family (8bit, 16bit, 32bit), Baseline, Mid-Range, Enhanced Mid-Range, PIC18FXXXX Architecture. **Device Overview:** Core, Device and Special Features, Block Diagram **Oscillator Configurations:** Oscillator types, Clock Sources and Oscillator Switching. **Power-Managed Modes:** Run, Sleep and Idle Modes **Reset:** RCON, MCLR, POR, BOR, **Memory Organization:** Program Memory Organization, Instruction Cycle, Data Memory Organization, Flash Program Memory, Data EEPROM Memory, 8 x 8 Hardware Multiplier, Interrupts. **Instruction Set:** Introduction, Instruction Formats, Special Function Registers as Source/Destination, Q Cycle Activity, Instruction Descriptions.	20

Unit 3	**Peripheral Support in PIC 18FXXXX**	lectures
	Timers and its Programing (mode 0 &1), Interrupt Structure of PIC18FXXXX with SFR, PORTB change Interrupts, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using ADC: All programs in embedded C.	15
Unit 4	Real Word Interfacing With 18FXXXX	lectures
	Port structure with programming, Interfacing of LED, LCD and Key board, Motion Detectors, DAC for generation of waveform, Design of PIC test Board and debugging, Home protection System: All programs in embedded C.	10
Unit 5	Serial Port Programming interfacing with 18FXXXX	lectures
	Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI & I2C), USART (Receiver and Transmitter), interfacing of RTC (DS1307) with I2C and EEPROM with SPI. Design of Traffic Light Controller; All programs in embedded C.	10

Text / Reference Books:

- **PIC Microcontrollers,** *by Lucio Di Jasio, Tim Wilmshurst, Dogan Ibrahim, John Morton, Martin P. Bates, Jack Smith, D. W. Smith, Chuck Hellebuyck.*
- **Programming and Customizing the PIC Microcontroller,** *by Myke Predko, McGrawHill.*
- **PIC Microcontroller and Embedded Systems,** *Mazidi, Mckinlay and Causey, Pearson Education.*

MOOC / NPTEL Courses:
NPTEL Course **"Microcontroller and Applications"**

Link of the Course: https://nptel.ac.in/courses/117/104/117104072/

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous),

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2102

Course Name: Electromagnetic Fields and Antennas

Teaching Scheme: TH: 4Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Physical quantities as vectors, concept of gradient, curl, and divergence, concept of rotation operator, covariant and contra-variant vectors, line, surface and volume – integrals, Gauss and Stokes theorem complex plane, polar form of complex number, complex functions, Cauchy-Riemann conditions, orthogonal functions and relation with Laplace equation.

Course Objectives:

- Provide the foundation and rudiments of Electromagnetic theory essential to subsequent courses of radiation, microwave and wireless communications.
- Expose the students to basic laws of electrostatics, magneto statics leading to the Maxwell Equations for static and dynamic fields.
- Extend these laws to Uniform Plane waves, transmission line theory and some of the case studies of applications of engineering electromagnetic field theory.
- The main focus will be on the physical interpretation of all the mathematical formulations and extend these concepts to real time applications in the field Electronics and communication.

Course Outcomes:

On completion of the course, student will be able to–

- Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
- Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
- Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- Understand the distribution of electromagnetic fields within various transmission line geometries
- Use Smith chart to study transmission line applications for circuit elements and impedance matching.
- Study the performance of Wave Guides

Course Contents

Chapter 1	Fundamentals of Electromagnetic Waves	12 lectures
	Prerequisite: Vector Analysis: Scalars and Vectors, Vector Algebra, Rectangular (Cartesian) Coordinate System, Vector Components and Unit Vector, Vector Field, Products, Cylindrical Coordinates, Spherical Coordinates, Differential Length, Area and Volume, Line Surface and Volume integrals, Del Operator, Gradient of a Scalar, Divergence and Curl of a Vector, the Laplacian. Electromagnetic Waves: Electromagnetic wave, the equation of continuity for time-varying fields, Maxwell's equations, EM waves in a homogeneous medium, wave propagation in conducting and non-conducting media, skin depth, Poynting's theorem, interpretation of E x H, Poynting theorem and its applications. Transmission lines: transmission line equation in time and frequency domain, losses and dispersion, reflection from an unknown load, quarter wavelength, single stub and double stub matching. Smith chart and its applications.	
Chapter 2	Waveguide and Components	18 lectures
	Concept of waveguides, frequency range, relation to transmission lines. Rectangular waveguides: TM and TE modes, the concept of cut-off frequency, waveguide impedance, phase velocity, guide wavelength for TE and TM modes, applications to TE mode in rectangular waveguide, power losses in rectangular waveguide, different methods of excitation of TE and TM modes in waveguides cavity resonators, Q factor of cavity resonators.	
Chapter 3	Antenna Basics	18 lectures
	Basic radiation equation, radiation resistance, antenna patterns, half-power bandwidth, radiation intensity, directivity and gain, resolution, apertures, effective heights, Frii's transmission formula, field zones, linear, elliptical and circular polarization, the duality of antenna, twin line antenna, center-fed dipole antenna, antenna field zone, ground wave, space wave and ionospheric propagation	
Chapter 4	Antenna Types	12 lectures
	The antenna family, a short dipole antenna, antenna arrays, broad-side and end-fire arrays, linear arrays, folded dipole, Yagi-Uda array, helical beam antenna, horn antenna, rhombic antenna, Hertz antenna, parabolic reflector antenna, loop antenna, antennas for terrestrial mobile communications, base station antennas, switched beam and beam forming antennas, antennas on cellular handsets and microstrip antenna.	

Text / Reference Books:

1) Microwave Devices and Circuits,by Samuel Y. Liao, PHI, 3rd Edition, 2002.
2) Principles of Electromagnetics, by N. Sadiku, Oxford University Press.
3) Electromagnetics with Applications, by Kraus and Fleiseh, McGraw Hill, 5th Edn, 1999.
4) Fundamentals of Applied Electromagnetics, by Fawwaz T. Ulaby, Eric Michielssen, Prentice Hall 6 Edition
5) Microwave and Radar Engineering with Lab Manual, by Vinith Chauhan, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.)

MOOC / NPTEL Courses:

1. NPTEL Course on "Transmission Lines and EM Waves -Video course" Prof. R.K. Shevgaonkar
Link of the Course: https://nptel.ac.in/courses/117/101/117101056/
2. NPTEL Course on "Electromagnetic theory - Video course" Dr. Pradeep Kumar K
Link of the Course: https://nptel.ac.in/courses/108/104/108104087/

Progressive Education Society's

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2103

Course Name: Electronic Practical Lab 2(Practical based on Hardware)

Teaching Scheme: PH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

A. Practical based on Communication Electronics

1 Design of AM transmitter and receiver.
2 Design of FM transmitter and receiver.
3 Delta modulation.
4 Design PCM encoder and decoder system.
5 Design of ASK / FSK transmitter and receiver.
6 Time division Multiplexing.

B. Practical based on Robotics

1 Move Car base robot forward, backward left turn, right turn programming.
2 Line following car base robot programming.
3 Pick and place robot arm programming.
4 Remote control robotic car programming

C. Practical based on PIC 18FXXXX microcontroller

1 Interfacing of LED, SSD, Switch, Thumb wheel.
2 Stepper motor interface to PIC.
3 Alphanumeric LCD interfacing in 8bit and 4bit mode
4 Sensors interface to ADC modules of PIC (Temperature Sensor, Humidity Sensor, Light Sensor etc.)
5 PWM module programming to control speed of DC motor, to control angle of servo motor and to control intensity of LED.
6 Store data and read data from internal EEPROM of PIC18.
7 Transfer and Receive data from EUSART (Interface GSM module/RFID/Bluetooth/Zigbee).
8 Implement Two-digit frequency counter or event counter using timer
9 Interfacing of resistive touch panel to PIC.
10 Real Time Clock interface using I2C bus of PIC.

D. **Practical on Electromagnetics**

1 To plot Equipotential contours and field lines for given charge distribution.
2 Smith chart for transmission line pattern and verify using MATLAB.
3 Simulation of potential distribution in a region bound by two conductors using of MATLAB.
4 Simulation of directivity pattern for simple antennas using of MATLAB
5 Practical based on simulink.

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2104

Course Name: Advanced Electronic communication Systems

Teaching Scheme: TH: 2 Hours/Week — Credit: 02

Examination Scheme: CIA: 25 Marks — End-Sem: 25 Marks

Prerequisite Courses:

- Basics of electronics.

Course Objectives: To make the students understand about:

- Recognize different communication systems
- Understand the difference between analog and digital communication system
- Understand concept of mobile communication system
- Know the concept, working and application of satellite communication system

Course Outcomes:

On completion of the course, student will be able to-

- Practically apply the knowledge of communication system to real life problems.
- Explain to society about digital communication.
- Review, prepare and explain technological developments.

Course Contents:

Unit 1	**Mobile Communication**	18 L
	Cellular concept: Introduction to basic cellular system, Cellular coverage planning, Mobile radio propagation, frequency reuse, Co-channel interference, Diversity, fading channels, spreading codes, power control, handoff, types of handoff, Multiple access. **Wireless networking:** Wireless systems and standards, WAP and other protocols for internet access. Blue-tooth and other wireless networks, system comparison. Spread spectrum concept. Basics of CDMA. Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/ standards. Multicarrier CDMA. Synchronization and demodulation. Diversity techniques and rake receiver. **Mobile Unit** Block diagram and operation of mobile unit, block diagram of cellular network, GSM architecture, making a call, receiving a call, GSM and CDMA technology and their applications.	
Unit 2	**Satellite communication**	12 L

	Introduction to satellite communication system, Importance of satellite communication system, concept of orbit and its types, Kepler's law, orbit tracking, satellite launching, attitude control, main and auxiliary propulsion subsystem, earth station and satellite sub systems, satellite link: uplink and downlink frequency, satellite link design and analysis, multiplexing techniques, multiple accesses for satellite links: FDMA, TDMA CDMA and DAMA, propagation effects, DBS-TV, GPS. VSAT: Network architecture, access control protocol and link analysis.	

Text / Reference Books:

1. Electronic Communication Systems, George Kennedy and Bernard Davis Publ. Tata McGraw Hill.
2. Electronic communications, Dennis Roddy and John Coolen, Pearson Publ.
3. Communication Electronics Principles and applications, Louis E. Frenzel, Tata McGraw Hill.
4. Advanced Electronic Communication systems, Tomasi W (6th edition), Pearson publication
5. Mobile cellular Telecommunications: Analog and Digital Systems (2nd edition) By William C.Y. Lee, McGraw-Hill,

MOOC / NPTEL Courses:

Introduction to Wireless and Cellular Communications

Link of the course: **https://archive.nptel.ac.in/courses/108/106/106106167/**

Satellite Communication Systems

Link of the course: **https://archive.nptel.ac.in/courses/117/105/117105131/**

Progressive Education Society's

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2201
Course Name: Solid State Devices (Elective)

Teaching Scheme: TH: 4Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:
- Fundamentals of semiconductor devices.
- Statistical analysis

Course Objectives:
- To provide an understanding of the characteristics of semiconductor devices.
- To introduce concept device simulators.
- To introduce quantum & statistical mechanics.
- To introduce the theory of diode, transistor & FET from semiconductor physics point of view.
- To study and understand energy band diagrams of devices.

Course Outcomes:

On completion of the course, student will be able to–
- Learn the important concepts related to semiconductor technology.
- Perform the analysis and design of semiconductor devices (electrostatics and current-voltage characteristics) from fundamental principles.
- Learn how to extract device parameters by suitable experiments.
- Learn the fundamentals of circuit design and observe how device properties and device design impact circuit behavior (e.g. dc and ac response, noise)

Course Contents:

Chapter 1	**Basics of Semiconductor Electronics**	lectures
	Energy bands and classifications, Band gap: direct and indirect, Atomic bonds in semiconductors, Commonly used semiconductors, Effect of temperature on semiconductors, Intrinsic and Extrinsic semiconductors, Carrier Concentration, Conductivity and Mobility, Carrier Generation and Recombination, compound semiconductors (III-V and II-VI group), properties of degenerate and non- degenerate semiconductors and their applications, Measurement of the energy gap, Measurement of the effective mass of carriers by using cyclotron resonance experiment, Measurement of a carrier lifetime, Haynes-Shockley experiment.	20
Chapter 2	**Junction Devices**	lectures
	PN junction diode, breakdown mechanism in p-n junction diode, junction, and diffusion capacitance. P-I-N diode, intrinsic layer, Principle of operation, P-I-N diode, applications of P-I-N diode.	10

	Zener diode: phenomenon of reverse bias breakdown, Principle of operation and applications, Schottky diode, Varactor diode: Principle of operation, structure and applications, **Tunnel diode:** Principle of operation, structure and applications, **BJT:**Terminology, electrostatics and performance parameters, Eber-Moll model, two port model, hybrid – pi model, device models in spice Modern BJT structures – polysilicon emitter BJT, Heterojunction bipolar transistor (HBT).	
Chapter 3	**FET and MOSFET Devices**	lectures
	JFET: Principle of operation, working, applications, MOSFET: accumulation, depletion mode, inversion mode and C-V characteristics of MOS capacitor, Constructional details I-V Characteristics, and Principle of operation of depletion type and enhancement type MOSFET, equivalent circuit of MOSFET, short channel and narrow width effect, MOSFET scaling and hot electron effect, charged-coupled devices(CCD) types of charged coupled device(SCCD and BCCD) application of charged coupled devices	10
Chapter 4	**Microwave and other advanced devices**	lectures
	Construction, Principle of operation and application of impact Avalanche Transit time (IMPATT) Diode, TRAPATT Diode, GUN Diode effect, the transferred electron mechanism, domain formation and various operating modes of GUN diode, TFT and Insulated Gate Bipolar transistor (IGBT).	20

Text / Reference Books:

1) Semiconductor Physics and Devices Basic Principles, *by Donald A. Neamen, TMH, 4th Edition (2003).*
2) Semiconductor Device fundamentals, *by Robert F. Pierret, Pearson Education*
3) Solid State Electronics Devices, *by Streetman, PHI, 5th Edition, (2006)*
4) Semiconductor Device Physics and Design, *by Umesh K. Mishra, Jasprit Singh, Springer Publication*
5) Semiconductor Physical Electronics, *by Sheng S. Li, 2e Springer Publication.*

MOOC / NPTEL Courses:

NPTEL Course on "Solid State Devices "

Link of the Course: https://archive.nptel.ac.in/courses/117/106/117106091/

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)
Course Code: 23ScEleP2202

Course Name: Nanoelectronics (Elective)

Teaching Scheme: TH: 4Hours/Week — Credit: 04

Examination Scheme: CIA: 50 Marks — End-Sem: 50 Marks

Prerequisite Courses:

- Basics of semiconductor Devices.

Course Objectives: To make the students understand about:

- To understand the processes in Nanoelectronics devices manufacturing.
- To understand the construction, characteristics, and operation of Nanoelectronic devices.
- To get acquainted with Nano-CMOS technology.
- To gain the concepts of Nanomaterial and Nanodevice fabrication.
- To understand the Nanomachines and nanodevice fabrication.
- To get acquainted with applications of Nanoelectronics in the electronics industry.

Course Outcomes:

On completion of the course, student will be able to-

- Understand the fundamental knowledge behind nanotechnology.
- Understand to Nano-CMOS technology.
- Explore various Nanoelectronics material.
- Understand the importance of carbon nanotubes.
- Understand Nanomaterial and Nanodevice fabrication.
- Understand various applications of Nanotechnology in Electronics.

Course Contents:

Unit 1	**Introduction to Nanotechnology and Nano CMOS Devices**	15 L
	Introduction to Nanotechnology: Fundamental science behind Nanotechnology, Tools for measuring Nanostructures, Tools to make nanostructures and imagine nano behaviors, Limitations of Silicon Material. Silicon Nanocrystal non-volatile memories, Novel dielectric materials for future transistors, Nano-CMOS devices, and applications, AFM, scanning probe instrument, nano scale lithography.	
Unit 2	**Nanoelectronics**	15 L
	Introduction, the tools of manufacturing of micro and nano fabrication optical lithography, electron beam lithography, atomic lithography. Nano-Electronics for advanced computation and communication**.**	
Unit 3	**Nanomachine and Nanodevice Fabrications**	15 L
	Nanomachines and Nanodevices, NEMS and MEMS and their fabrication, molecular and supermolecular switches, Lithography**.**	

Unit 4	**Applications of Nanotechnology**	15 L
	Use of Nanotechnology in Electronics: Application of nanostructures in electronics, sensors, optics, energy capture, transformation, and storage. Application of nanotechnology in biomedical electronics.	

Text / Reference Books:

1 "Nanotechnology for Electronic Materials and Devices" by Anatoli Korkin, Jan Labanowski, Evgeni Gusev, Serge Luryi, Springer.

2 "Nanotechnology: A Gentle introduction to a next big Idea", by Mark Ratner, Daniel Ratner, 1st Edition, Pearson Education.

3 "Nanotechnology", by Gregory Timp, Springer.

4 Introduction to Nanotechnology", by Charles P. Poole Jr., Frank J. Owens, "John Wiley and sons

MOOC / NPTEL Courses:

1 NPTEL Course on "Nanostructured materials-synthesis,properties,self assembly and applications", by Prof. A.K.Ganguli IIT Delhi
Link of the course: https://nptel.ac.in/courses/118102003

2 NPTEL Course on "Nanoelectronics: Devices and Materials", by Dr. Navkanta Bhat, Dr. S.N.Shivashankar, Prof. K.N.Bhat IISc Bangalore
Link of the course: https://nptel.ac.in/courses/117108047

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous),

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PG First Year of M.Sc. Electronic Science
(2023 Course under NEP 2020)

Course Code: 23ScEleP2041
Course Name: On Job Training/ Field Project

Teaching Scheme: TH: 8Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

Basic knowledge of electronic science and computer programming

Course Objectives:

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Course Outcomes:

On completion of the internship, learner will be able to –

- To develop professional competence through internship.
- To apply academic knowledge in a personal and professional environment.
- To build the professional network and expose students to future employees.
- Apply professional and societal ethics in their day to day life.
- To become a responsible professional having social, economic and administrative considerations.
- To make own career goals and personal aspirations

On job training (OJT) or Field project is career development opportunities, providing practical experience in a field or discipline OJT or filed project is more important as the employers are looking for employees who are properly skilled and having awareness about industry environment practices and culture. OJT or Field project is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Duration:

OJT or Field project to be completed after semester 1 and before commencement of semester 2 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 2.

Framework of OJT/ Field Project /Internship:

- Students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions.
- Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.
- Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop.
- During the vacation after 1st semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities.
- Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him. The evaluation of these activities will be done by Programmed Head / Cell In-charge / Project Head / TPO / faculty mentor or Industry Supervisor

a) Guidelines to the Institute:

Department will arrange field project / OJT/ internship for students in industries / organization after first semester .The general procedure for arranging internship is given below:

- Step 1: Request Letter/ Email should go to industry to allot various slots of 4-6 weeks as internship periods for the students. Students request letter /profile / interest areas may be submitted to industries for their willingness for providing the training.
- Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students.
- Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.
- Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.
- Step 5: Students will submit training report after completion of internship.
- Step 6: Training Certificate to be obtained from industry.
- Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell.

Guidelines to the students:
Any absenteeism by students during their internship should be informed immediately to the mentor/reporting manager and the internal guide. No special considerations will be accepted. Students cannot take leave for college work or fest activities. The leave permission for any college related activities will be solely approved by the HOD. The monthly attendance format should be duly submitted to the internal guide by the intern.
Internal reporting Guidelines:
Every intern should send weekly report to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guide on regular basis. Interns should have at least fortnightly verbal communication with the internal guide without fail. In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.
Internship Diary / Internship Workbook:
Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary account of the observations, impressions, information gathered and
suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.
Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. Internship Diary / workbook may be evaluated on the basis of the following criteria:
• Proper and timely documented entries.
• Adequacy & quality of information recorded
• Data recorded.
• Thought process and recording techniques used.
• Organization of the information

Internship Work Evaluation:
Every student is required to prepare a maintain documentary proofs of the activities done by him / her as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/ Cell In-charge / Project Head / faculty mentor or Industry Supervisor based on- overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.
Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External - a supervisor from place of internship).
Evaluation through Seminar presentation / Viva-voce at the institute:
The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- ✓ Depth of knowledge and skills Communication & Presentation Skills.
- ✓ Team Work
- ✓ Creativity
- ✓ Planning & Organizational skills
- ✓ Adaptability and Analytical Skills
- ✓ Attitude & behavior at work.
- ✓ Societal Understanding
- ✓ Ethics
- ✓ Regularity and punctuality

- ✓ Attendance record
- ✓ Log book
- ✓ Student's Feedback from External Internship Supervisor

Internship Report:

The report shall be presented covering following recommended fields but limited to:

- ✓ Title/Cover Page
- ✓ Internship completion certificate.
- ✓ Internship Place Details- Company background-organization and activities/Scope and object of the study / personal observation.
- ✓ Index/Table of Contents
- ✓ Introduction
- ✓ Title/Problem statement/objectives
- ✓ Motivation/Scope and rationale of the study
- ✓ Methodological details
- ✓ Results / Analysis /inferences and conclusion
- ✓ Suggestions / Recommendations for improvement to industry, if any
- ✓ Attendance Record
- ✓ List of reference (Library books, magazines and other sources)