

**Academic Council Approval Date: 26/05/2026**

**FYUP 7<sup>th</sup> Semester**

Course Code	Name of the Course	Marks					Credits		
		End Sem Exam			IA	Total	Th	Pr	Total
		Th	Pr	Total					
ELE-400	<b>Major:</b> Research Methodology	75	-	75	25	100	4	-	4
ELE-401	<b>Major:</b> Optical Communication System	75	-	75	25	100	4	-	4
ELE-402	<b>Minor:</b> Electrical Network analysis	75	-	75	25	100	4	-	4
ELE-403	<b>Major:</b> Power Electronics	56	19	75	25	100	3	1	4
ELE-404	<b>Major:</b> Electrical Network analysis	75	-	75	25	100	4	-	4
<b>Total</b>									<b>20</b>

**FYUP 8<sup>th</sup> Semester**

Course Code	Name of the Course	Marks					Credits		
		End Sem Exam			IA	Total	Th	Pr	Total
		Th	Pr	Total					
ELE-450	<b>Major:</b> Numerical analysis	75	-	75	25	100	4	-	4
ELE-451	<b>Minor:</b> Numerical analysis	75	-	75	25	100	4	-	4
ELE-452	Research Project/ Dissertation (Honours with Research only)	-	-	-	-	300	-	-	12
ELE-453	<b>Major: Basics of VLSI Design</b>	56	19	75	25	100	3	1	4
ELE-454	<b>Major:</b> Physics of Semiconductor and nanoelectronics	75	-	75	25	100	4	-	4

ELE-455	<b>Major:</b> Linear integrated circuit Numerical analysis	56	19	75	25	100	4	-	4
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**For students opting for 4-year UG Degree (Honours), the courses to be taken in Semester 8 are ELE--40, ELE-451, ELE-453, ELE-454 and ELE-455.**

**For students opting for 4-year UG Degree (Honours with Research), the courses to be taken in Semester 8 are ELE-450, ELE-451 and ELE-452.**

### **ELE-401: OPTICAL FIBER COMMUNICATION (Hours: 60, Credits: 4)**

#### **Learning Objectives:**

Students will understand light as an electromagnetic wave and various phenomena like interference, diffraction and polarization; interactions between a photon and electron and their relevance to laser and other optoelectronic devices. Understand the propagation of wave in optical fiber.

#### **Course Outcomes:**

- CO1. Classify and describe working of optical fiber with different modes of signal propagation.
- CO2. Describe the transmission characteristics and losses in optical fiber communication.
- CO3. Describe the construction and working principle of optical connectors, multiplexers and amplifiers.
- CO4. Describe the constructional features and the characteristics of optical Sources and detectors

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to <u>optical fiber</u> communication	15	20	25
II	Transmission characteristics and losses in optical fiber communication	15	15	
III	Principle of optical connectors, multiplexers and amplifiers.	15	20	
IV	Features and the characteristics of optical Sources and detectors	15	20	

Total	60	75	25
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### Unit-1

Historical development, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers

### Unit-2

Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.

Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers, Optical Isolators and Circulators

### Unit-3

Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies.

Physical principles of Photodiodes, Photo detector noise, Detector response time. Optical Receiver Operation: Error sources. Front End Amplifiers, Receiver sensitivity

### Unit-4

Overview of WDM: Operational Principles of WDM, WDM standards Isolators and Circulators, Fiber grating filters, Optical amplifiers: Basic application and Types. Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Wideband Optical Amplifiers

### Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

### Exam Duration

Theory	3 Hours
Practical	-

### Suggested Readings

**Text Books:**

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, Mc Graw Hill Education (India) Private Limited, 2015. ISBN: 1-25-900687-5.
2. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN: 978-81-317-3266-3

**References:**

1. Joseph C Palais, Fiber Optic Communication, Pearson Education, 2005, SBN:0130085103

**ELE-402(Minor): Electrical Network Analysis  
(Hours: 75, Credits: 4)**

**Learning Objectives**

The students will study the basic circuit concepts in a systematic manner suitable for analysis and design. They will also study and analyze the transient and steady-state response of circuits and will be able to analyze electric circuits using network theorems and two-port parameters.

**Course Outcomes**

At the end of this course, students will be able to:

- CO1 Identify and analyze AC circuit elements, resonance, and power parameters.
- CO2 Apply network topology and theorems to simplify and evaluate complex networks.
- CO3 Synthesize two-terminal RL and RC networks using Foster and Causer forms.
- CO4 Perform computational analysis and practical simulations of electronic circuits using industry-standard (Open Source) software.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to circuit elements and basic laws	20	20	19+ 6(hands-on)
II	Network theorems for AC	15	20	
III	Network synthesis	10	15	
IV	Simulations using LTSPICE	15	20	
Total		60	75	25

## Syllabus Contents

### Unit-I

Introduction to circuit elements; classification of elements; ideal and practical voltage and current sources; nullators and norators. Sinusoidal signals, RMS and average values, phasor representation, and application in AC circuit analysis. AC response of resistance, inductance, and capacitance. Kirchhoff's laws in AC circuits; impedance and admittance in series and parallel configurations. Source transformations and equivalent circuits. Resonance in series and parallel circuits; resonance curves; quality factor and selectivity; self-resonance of coils. Power in AC circuits—instantaneous, average, and reactive. Poles and zeros; circuit behavior in the frequency domain; locus diagrams and duality.

### Unit-II

Network topology and variables, mesh and node analysis, matrix representation, dual and inverse networks, driving point and transfer impedances, state variable analysis. Graph theory and network applications, incidence, tie-set, and cut-set matrices, generalized network equations. Network conversions and theorems, two-port networks and their reduction, bridged-T and lattice networks, superposition, Millman's, Thevenin's, Norton's, reciprocity, substitution, compensation, maximum power transfer, and Tellegen's theorem.

### Unit-III

Foster's reactance theorem, pole-zero separation, reactance function realization, forms of reactance and admittance functions, canonic and continued fraction (Cauer) networks. Synthesis of two-terminal R.L. and R.C. networks using driving-point functions and continued fraction expansion. Positive real functions, properties and tests, Hurwitz criteria, and real part testing for synthesis validity.

### Unit-IV

Practical Oriented Learning - SPICE Simulation and Circuit Evaluation: Overview of SPICE, PSpice, and LTspice simulation environments. Analysis of resistive circuits with independent and dependent sources, transient and AC response analysis. Hands-on modeling of resonance, network theorems, and two-port network validation.

### Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

## Exam Duration

Theory	3 Hours
Practical	-

## Suggested Readings

### Text Books:

1. Hayt, William H., et al. Engineering Circuit Analysis. 10th ed., McGraw-Hill, 2024.
2. Sudhakar, A., and S. S. Palli. Circuits and Networks: Analysis and Synthesis. 6th ed., McGraw-Hill Education India, 2025.
3. Alexander, Charles K., and Matthew N. O. Sadiku. Fundamentals of Electric Circuits. 7th ed., McGraw-Hill, 2023.

### References

1. Van Valkenburg, M. E. Network Analysis. Prentice Hall of India, 2006.
4. Kuo, Franklin F. Network Analysis and Synthesis. 2nd ed., Wiley, 2006.

## **ELE-403: Power Electronics** (Hours: 75, Credits: 3+1=4)

### Learning Objectives

Students will learn the use of electronics for control and conversion of electrical power, the concept of high power devices, their construction and their applications. They will understand the concept of converters and inverters and the importance about their applications for Dc to Ac and Ac to Ac conversion.

### Course Outcomes

- CO1 Explain the basic principles of power devices, switch mode power conversion, models of different types of power electronic converters including dc-dc converters, PWM rectifiers and inverters
- CO2 Choose appropriate power converter design for various applications.
- CO3 Describe the operation of converters, rectifiers and choppers along with their controls.
- CO4 Analyze the performance of Power converters

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to Power devices	10	16	19
II	VI characteristics and applications	20	20	
III	Power inverters and choppers	15	20	
IV	Practical	30	19	6
Total		75	75	25

## Syllabus Contents

### Unit- I

Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors. Basic structure, of following power devices Insulated Gate Bipolar Transistors (IGBT), Power MOSFETs and BJT, Silicon Controlled Rectifier (SCR)

### Unit- II

Diac and Triac: Working and V-I characteristic, application of a Diac as a triggering device for a Triac. Insulated Gate Bipolar Transistors (IGBT): I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc. Application of SCR: SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and Triac as a switch. Control circuits design and Protection circuits, Snubber circuit. Power MOSFETs & power BJT: switching characteristics and applications.

### Unit-III

**Power Inverters:** Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors.

**Choppers:** basic chopper circuit, types of choppers (Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper (using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper

### Unit- IV

## PRACTICALS

1. To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel POWER MOSFET.
2. To plot the (i) output characteristics & (ii) transfer characteristics of a POWER BJT.
3. To design of a SMPS circuit.
4. To design an inverter circuit.
5. To design and plot the characteristics a SCR.
6. To design a half wave rectifier and full wave rectifier using a SCR.
7. To plot the characteristics of a TRIAC and DIAC.
8. Design of a DC chopper.

### Instructions to Paper Setter (Theory)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
<b>Total</b>	<b>6</b>	<b>3</b>

### Instructions to Paper Setter (Practical)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
IV (Practical)	Ten	1 on the basis of lottery

#### Exam Duration:

Theory	3 hours
Practical	3 hours

#### Suggested Readings

##### Text Books:

1. Sen, P. C. Power Electronics. Tata McGraw-Hill, 1987.
5. Dutta, S. K. Power Electronics and Controls. PHI Learning, 2006.

##### References

6. Singh, M. D., and K. B. Khanchandani. Power Electronics. Tata McGraw-Hill, 2007.
7. Rashid, Muhammad H. Power Electronics: Circuits, Devices, and Applications. 3rd ed., Pearson Education, 2004.

**ELE-404 (Major): Electrical Network Analysis**  
**(Hours: 60, Credits: 4)**

**Learning Objectives**

The students will study the basic circuit concepts in a systematic manner suitable for analysis and design. They will also study and analyze the transient and steady-state response of circuits and will be able to analyze electric circuits using network theorems and two-port parameters.

**Course Outcomes**

At the end of this course, students will be able to:

- CO1 Identify and analyze AC circuit elements, resonance, and power parameters.
- CO2 Apply network topology and theorems to simplify and evaluate complex networks.
- CO3 Synthesize two-terminal RL and RC networks using Foster and Cauer forms.
- CO4 Perform computational analysis and practical simulations of electronic circuits using industry-standard (Open Source) software.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to circuit elements and basic laws	20	20	19+ 6(hands-on)
II	Network theorems for AC	15	20	
III	Network synthesis	10	15	
IV	Simulations using LTSPICE	15	20	
Total		60	75	25

**Syllabus Contents**

**Unit-I**

Introduction to circuit elements; classification of elements; ideal and practical voltage and current sources; nullators and norators. Sinusoidal signals, RMS and average values, phasor representation, and application in AC circuit analysis. AC response of resistance, inductance, and capacitance. Kirchhoff's laws in AC circuits; impedance and admittance in series and parallel configurations. Source transformations and equivalent circuits. Resonance in series and parallel circuits; resonance curves; quality factor and selectivity; self-resonance of coils.

Power in AC circuits—instantaneous, average, and reactive. Poles and zeros; circuit behavior in the frequency domain; locus diagrams and duality.

## Unit-II

Network topology and variables, mesh and node analysis, matrix representation, dual and inverse networks, driving point and transfer impedances, state variable analysis. Graph theory and network applications, incidence, tie-set, and cut-set matrices, generalized network equations. Network conversions and theorems, two-port networks and their reduction, bridged-T and lattice networks, superposition, Millman's, Thevenin's, Norton's, reciprocity, substitution, compensation, maximum power transfer, and Tellegen's theorem.

## Unit-III

Foster's reactance theorem, pole-zero separation, reactance function realization, forms of reactance and admittance functions, canonic and continued fraction (Cauer) networks. Synthesis of two-terminal R.L. and R.C. networks using driving-point functions and continued fraction expansion. Positive real functions, properties and tests, Hurwitz criteria, and real part testing for synthesis validity.

## Unit-IV

Practical Oriented Learning - SPICE Simulation and Circuit Evaluation: Overview of SPICE, PSpice, and LTSpice simulation environments. Analysis of resistive circuits with independent and dependent sources, transient and AC response analysis. Hands-on modeling of resonance, network theorems, and two-port network validation.

### Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

### Exam Duration

Theory	3 Hours
Practical	-

### Suggested Readings

#### Text Books:

1. Hayt, William H., et al. Engineering Circuit Analysis. 10th ed., McGraw-Hill, 2024.

- Sudhakar, A., and S. S. Palli. Circuits and Networks. 6th ed., McGraw-Hill Education India, 2025.

### References

- Alexander, Charles K., and Matthew N. O. Sadiku. Fundamentals of Electric Circuits. 7th ed., McGraw-Hill, 2023.
- Van Valkenburg, M. E. Network Analysis. 3rd ed., Prentice Hall of India, 2006.
- Kuo, Franklin F. Network Analysis and Synthesis. 2nd ed., Wiley, 2006.

## **ELE-450(Major): Numerical Analysis for Electronics** (Hours: 60, Credits: 4)

### Learning Objectives:

The course is designed to provide students with basic numerical analysis concepts, equip students with the knowledge of problem solving skills and basic of implementing numerical analysis using C Programs.

### Course Outcomes:

At the end of this course, students will be able to:

- CO1 Formulate roots of algebraic and transcendental equations using numerical methods.
- CO2 Apply numerical interpolation, curve fitting, and integration techniques to engineering data.
- CO3 Solve ordinary differential equations governing the transient behavior of electronic circuits.
- CO4 Develop C programs to implement numerical algorithms for embedded systems applications.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to Linear algebraic equations	15	20	25
II	Interpolation, numerical differentiation and Integration	15	20	
III	Ordinary Differential Equations (ODEs):	10	15	
IV	Writing structured C programs to	20	20	

	solve numerical methods			
Total		60	75	25

## Syllabus Contents

### Unit-1

Numerical Solution of Algebraic Equations: Floating-point arithmetic, errors and approximations. Roots of equations: Bisection method, Newton-Raphson method, Secant method. Solution of simultaneous linear algebraic equations: Gauss elimination, Gauss-Jordan, and Gauss-Seidel iterative methods. Applications to nodal and mesh equations in electronic circuits.

### Unit-2

Interpolation, Integration, and Curve Fitting: Finite differences, Forward and Backward difference interpolation (Newton's formulae). Curve fitting using the method of least squares. Numerical differentiation and Integration: Trapezoidal rule, Simpson's 1/3rd and 3/8th rules. Application of integration to calculate RMS values and signal power.

### Unit-3

Ordinary Differential Equations (ODEs): Initial value problems. Taylor series method, Euler's method, Modified Euler's method. Runge-Kutta 4th order method. Application of ODE solutions to analyze RL, RC, and RLC transient circuits and control systems.

### Unit-4

Writing structured C programs to solve numerical methods (e.g., coding Newton-Raphson and Runge-Kutta). Adapting C algorithms for microcontrollers (such as Arduino) for real-time computation, filtering, and sensor data processing.

### Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

### Exam Duration

Theory	3 Hours
Practical	-

## Suggested Readings

### Texts:

1. Grewal, B. S. Numerical Methods in Engineering and Science. 44th ed., Khanna Publishers, 2014.
8. Kreyszig, Erwin. Advanced Engineering Mathematics. 10th ed., John Wiley & Sons, 2011.
9. Kanetkar, Yashavant. Let Us C. 17th ed., BPB Publications, 2020.
10. Kernighan, Brian W., and Dennis M. Ritchie. The C Programming Language. 2nd ed., Prentice Hall, 1988..

## References

1. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall India, Third Edition.
1. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India (2008).
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
3. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).

## **ELE-451(Minor): Numerical Analysis for Electronics** **(Hours: 60, Credits: 4)**

### Learning Objectives:

The course is designed to provide students with basic numerical analysis concepts, equip students with the knowledge of problem solving skills and basic of implementing numerical analysis using C Programs.

### Course Outcomes:

At the end of this course, students will be able to:

- CO1 Formulate roots of algebraic and transcendental equations using numerical methods.
- CO2 Apply numerical interpolation, curve fitting, and integration techniques to engineering data.
- CO3 Solve ordinary differential equations governing the transient behavior of electronic circuits.
- CO4 Develop C programs to implement numerical algorithms for embedded systems applications.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to Linear algebraic equations	15	20	25
II	Interpolation, numerical differentiation and Integration	15	20	
III	Ordinary Differential Equations (ODEs):	10	15	
IV	Writing structured C programs to solve numerical methods	20	20	
Total		60	75	25

## Syllabus Contents

### Unit-1

Numerical Solution of Algebraic Equations: Floating-point arithmetic, errors and approximations. Roots of equations: Bisection method, Newton-Raphson method, Secant method. Solution of simultaneous linear algebraic equations: Gauss elimination, Gauss-Jordan, and Gauss-Seidel iterative methods. Applications to nodal and mesh equations in electronic circuits.

### Unit-2

Interpolation, Integration, and Curve Fitting: Finite differences, Forward and Backward difference interpolation (Newton's formulae). Curve fitting using the method of least squares. Numerical differentiation and Integration: Trapezoidal rule, Simpson's 1/3rd and 3/8th rules. Application of integration to calculate RMS values and signal power.

### Unit-3

Ordinary Differential Equations (ODEs): Initial value problems. Taylor series method, Euler's method, Modified Euler's method. Runge-Kutta 4th order method. Application of ODE solutions to analyze RL, RC, and RLC transient circuits and control systems.

### Unit-4

Writing structured C programs to solve numerical methods (e.g., coding Newton-Raphson and Runge-Kutta). Adapting C algorithms for microcontrollers (such as Arduino) for real-time computation, filtering, and sensor data processing.

## Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

### Exam Duration

Theory	3 Hours
Practical	-

### Suggested Readings

#### Texts:

1. Grewal, B. S. Numerical Methods in Engineering and Science. 44th ed., Khanna Publishers, 2014.
11. Kreyszig, Erwin. Advanced Engineering Mathematics. 10th ed., John Wiley & Sons, 2011.
12. Kanetkar, Yashavant. Let Us C. 17th ed., BPB Publications, 2020.
13. Kernighan, Brian W., and Dennis M. Ritchie. The C Programming Language. 2nd ed., Prentice Hall, 1988..

### References

4. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall India, Third Edition.
5. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India (2008).
6. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
7. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).

## ELE-453 Basics VLSI Design (Hours: 75, Credits: 3+1)

### Learning Objectives:

Students will be able to represent information in various number systems and convert data from one number system to another, do various arithmetic calculations. They will understand VLSI design methodologies and design simple digital systems, understand the HDL design flow and write programs in Verilog.

### Course Outcomes:

At the end of this course, students will be able to:

- CO1 Understand the concept of models of MOS devices and their implementation in designing of CMOS inverter.
- CO2 Measure the performance parameters like threshold voltage, noise margins, time delays etc.
- CO3 Familiarize with the techniques and components involved in combinational MOS circuit designs
- CO4 Describe the various types of semiconductor memories and issues involved in them

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to Power devices	10	16	19
II	VI characteristics and applications	20	20	
III	Power inverters and choppers	15	20	
IV	Practical	30	19	6
Total		75	75	25

## Syllabus Contents

### Unit- 1

**Metal Oxide Semiconductor (MOS):** Introduction to basic principle of MOS transistor, large signal MOS models (long channel) for digital design. MOS SPICE model, MOS device layout: Transistor layout, Inverter layout, CMOS digital circuit layout.

### Unit- II

**MOS Inverter:** Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, Dynamic behavior, Propagation Delay and Power Consumption.

### Unit -III

**Combinational MOS Logic Design:** Static MOS design, Pass Transistor logic, complex logic circuits. Sequential MOS Logic Design - Static latches, Flip flops & Registers, Dynamic Latches & Registers, CMOS Schmitt trigger, Nonstable sequential Circuits, Astable Circuits.

**Memory Design:** ROM & RAM cells design. Dynamic MOS design- Dynamic logic families and performances. Interconnect & Clock Distribution- Interconnect delays, Cross Talks, Clock Distribution.

### UNIT IV

1. Design of a half adder circuit
2. Design of a full adder circuit
3. Design of a half subtractor circuit
4. Design of a full subtractor circuit
5. Design of a two bit comparator circuit
6. Design of a three bit comparator circuit
7. Design of a four bit adder circuit
8. To design and plot the characteristics of a 4x1 digital multiplexer using pass

#### Instructions to Paper Setter (Theory)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
<b>Total</b>	<b>6</b>	<b>3</b>

#### Instructions to Paper Setter (Practical)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
IV (Practical)	Ten	1 on the basis of lottery

**Exam Duration:**

Theory	3 hours
Practical	3 hours

**Suggested Readings****Text :**

1. Weste and Eshraghian, "Principles of CMOS VLSI design" Addison-Wesley, 2002.
2. Basic VLSI design: Douglas A Pucknell, Kamran Eshraghian, PHI, 3rd edition

**References:**

1. Kang & Leblebici "CMOS Digital IC Circuit Analysis & Design"- McGraw Hill, 2003.
2. Rabey, "Digital Integrated Circuits Design", Pearson Education, Second Edition, 2003.

**ELE-454 Physics of Semiconductor Devices and Nanoelectronics**  
**(Hours: 60, Credits: 4)**

**Learning Objectives:**

The students will be equip with the basic understanding of fundamental physics law governing semiconductor devices, give them an understanding about basic analysis of their operations, characterisation and working along with the understanding about the basics of simulating semiconductor devices.

**Course Outcomes:**

At the end of this course, students will be able to:

- CO1 Describe the crystal structures, carrier transport, and physics of elemental and compound semiconductors.
- CO2 Analyze the operation of p-n junctions, metal-semiconductor contacts, and classical semiconductor devices.
- CO3 Evaluate quantum transport phenomena and the operating principles of advanced nanoscale architectures, including HEMTs and wide band gap materials.
- CO4 Understand structural and electrical characterization, alongside device simulation for parameter optimization and fabrication analysis.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction to Semiconductor Physics and Carrier Transport	20	20	25
II	Junctions and Semiconductor Devices	15	20	
III	Basics of Nanoelectronics	10	15	
IV	characterization techniques	15	20	
Total		60	75	25

## Syllabus Contents

### Unit-1

Semiconductor Physics and Carrier Transport: Crystal structures and bonding in elemental and compound semiconductors. Formation of energy bands and classification of solids. Carrier concentration in intrinsic and extrinsic semiconductors, Fermi level behavior, and temperature dependence. Concepts of effective mass, mobility, drift and diffusion currents. Continuity equation and carrier recombination-generation mechanisms. Quasi-Fermi levels and transport equations.

### Unit-II

Junctions and Classical Semiconductor Devices: Equilibrium and non-equilibrium analysis of p-n junctions. Depletion approximation, built-in potential, minority and majority carrier distributions, and current-voltage characteristics. Energy band diagrams under various bias conditions. Metal-semiconductor/ohmic/Schottky contacts, barrier formation, and current transport mechanisms. Bipolar junction transistor operation, base transport factor, current gain, and small-signal models. MOS capacitor electrostatics, threshold voltage, and MOSFET I-V behavior in various operating regions.

### Unit-III

Quantum Transport and Advanced Nanoscale Devices Concepts: Quantum confinement and energy quantization in low-dimensional systems. Density of states in 1D and 2D structures. Breakdown of classical scaling, short-channel effects, and quantum tunneling phenomena. Ballistic transport and Landauer formalism. Device architecture and operating principles of FinFETs, Tunnel FETs, and single-electron transistors. Two-dimensional materials and their application in next-generation semiconductor devices. Advanced device structures including HEMTs, SiGe HBTs, and wide bandgap semiconductor devices based on GaN, cBN, and diamond.

## Unit-IV

Practical Oriented Learning - Nano Scale Device Fabrication, Simulation, and Characterization: Electrical characterization techniques including four-point probe, Hall effect, I–V and C–V measurements. Structural analysis using X-ray diffraction, scanning electron microscopy, transmission electron microscopy, and atomic force microscopy. Spectroscopic analysis using Raman spectroscopy, photoluminescence, and X-ray photoelectron spectroscopy. TCAD device simulation (e.g., using Silvaco) for modeling, calibration, and optimization of advanced structures like HEMTs.

### Instructions to Paper Setter

Questions should be set according to the following scheme.

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
IV	2	1
<b>Total</b>	<b>8</b>	<b>4</b>

### Exam Duration

Theory	3 Hours
Practical	-

### Suggested Readings:

#### Text:

1. Sze, S. M. Semiconductor Devices: Physics and Technology. 2nd ed., Wiley India, 2008.
14. Streetman, Ben G., and Sanjay Kumar Banerjee. Solid State Electronic Devices. 7th ed., Pearson Education, 2015.
15. Singh, Jasprit. Semiconductor Devices: Basic Principles. John Wiley and Sons, 2001.
16. Kelsall, Robert W., Ian W. Hamley, and Mark Geoghegan. Nanoscale Science and Technology. John Wiley and Sons, 2005.

#### Reference:

17. Kelsall, Robert W., Ian W. Hamley, and Mark Geoghegan. Nanoscale Science and Technology. John Wiley & Sons, 2005.
18. Edelstein, Alan S., and Robert C. Cammarata, editors. Nanomaterials: Synthesis, Properties and Applications. Institute of Physics Publishing, 1998.
19. Poole, Charles P., Jr., and Frank J. Owens. Introduction to Nanotechnology. Wiley-Interscience, 2003.
20. Goodhew, Peter J., John Humphreys, and Richard Beanland. Electron Microscopy and Analysis. 2nd ed., Taylor & Francis, 2000.

## **ELE-455: Linear Integrated Circuits**

**(Hours: 75, Credits: 3+1=4)**

### **Learning Objectives:**

The course is designed to provide students to impart basics understanding about OP-AMPs and special ICs along with their application. It also aims to equip students with the knowledge of designing circuits using OP-AMPs and special ICs.

### **Course Outcomes:**

At the end of this course, students will be able to:

- CO1 Identify and analyze Op Amp circuits.
- CO2 Apply Op Amp in various application circuits.
- CO3 Synthesize various Linear Integrated circuits.
- CO4 Perform advance Op amp and LIC.

UNIT	Topic	Hours	External Marks	Internal Marks
I	Introduction and review of Op Amp	20	18	19
II	Op amp application	15	19	
III	Application of Linear Integrated Circuits	10	19	
IV	Practicals	30	19	6
Total		75	75	25

### **UNIT I**

Review of Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP. Dominant pole compensation, pole zero compensation, lead compensation, step response of OP AMPs.

### **UNIT II**

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OP- **amp**.

### UNIT III

Functional block, characteristics of 555 Timer and its PWM application – IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs. AD623 Instrumentation Amplifier and its application as load cell weight measurement – IC voltage regulators – LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply – LM317, 723 Variability voltage regulators, switching regulator- SMPS – ICL 8038 function generator IC.

### UNIT IV

#### Practicals

1. Design of a VCO using a 741 IC
2. Design of a PLL using a 565
3. Design a second order high pass butterworth filter using 741 IC.
4. Design a second order low pass butterworth filter using 741 IC.
5. Design a instrumentation amplifier using 741 IC.
6. Design and testing of Triangular Wave generator using 741 IC
7. Design of an adjustable regulator using LM317.
8. Design of an adjustable regulator using 78XX and 79XX series.
9. Design of ADC using IC0808.
10. Design of DAC using IC0808.

#### Instructions to Paper Setter (Theory)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
I	2	1
II	2	1
III	2	1
<b>Total</b>	<b>6</b>	<b>3</b>

### Instructions to Paper Setter (Practical)

Questions should be set according to the following scheme:

Unit	Questions to be set	Questions to be answered
IV (Practical)	Ten	1 on the basis of lottery

#### Exam Duration:

Theory	3 hours
Practical	3 hours

#### Suggested Readings

#### Texts:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)

#### References:

21. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
22. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
23. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)