

ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం  
ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయ  
Central University of Andhra Pradesh  
Jnana Seema, Ananthapuramu

**School of Interdisciplinary and Applied Sciences**

**Department of Computer Science and AI**



***Vidya Dadati Vinayam***  
(Education Gives Humility)

**PG Diploma in Semiconductor Technology & Chip Design**

w.e.f. Academic Year 2025 - 2026

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# **PG Diploma in Semiconductor Technology & Chip Design**

## **Introduction to the Programme**

Postgraduate Diploma programmes are being offered by CUAP from the 2025–26 academic year. Semiconductor Technology and Chip Design form the backbone of modern electronics, enabling innovations in computing, telecommunications, automotive systems, healthcare devices, and industrial automation. This programme is designed to equip students with the knowledge and technical expertise needed to design, fabricate, and optimize integrated circuits (ICs) and system-on-chip (SoC) solutions.

The curriculum covers semiconductor physics, electronic circuit simulation, fabrication processes, hardware description languages, testing and verification methodologies, and low-power design strategies. It also emphasizes industry-relevant tools and hands-on training using Electronic Design Automation (EDA) software to meet the growing demand for skilled semiconductor professionals in both design and manufacturing.

### **Objectives:**

- To provide foundational and advanced knowledge in semiconductor devices, microelectronics, and chip fabrication processes.
- To develop skilled professionals capable of designing, simulating, and verifying integrated circuits and SoCs using industry-standard tools.
- To empower learners with hands-on experience through fabrication labs, simulation environments, and real-world chip design projects.

A student completing this programme will be capable of pursuing a career in semiconductor design, verification, fabrication, and embedded hardware development.

### **Learning Outcomes:**

On successful completion of the programme, students should be able to:

- Apply principles of semiconductor physics, microelectronics, and the design of integrated circuits.
- Use hardware description languages (VHDL, Verilog, or System Verilog) to implement and verify digital and mixed-signal designs.
- Perform chip-level simulations, testing, and performance optimization for different applications.

- Understand fabrication processes, packaging, and reliability considerations in semiconductor manufacturing.

**Programme Structure:**

- Post Graduate Diploma is a one-year program divided into two semesters with a total of around 40 credits.
- The program is designed with a combination of Core Courses and MOOCS.
- Students need to complete 2 MOOC courses in I,II semester.
- In semester II students will undergo for Dissertation Work.

## Programme Structure

S. No	Course Code	Title of the Course	Total Credits	Credits Distributions		
				L*	T*	P*
<b>Semester– I</b>						
1.	PDSCT101	Fundamentals of Semiconductor Devices	4	3	0	1
2.	PDSCT102	Fundamentals of Power Electronics	4	3	0	1
3.	PDSCT103	Introduction to Digital System Design	4	3	0	1
4.	PDSCT111	MOOCs/NPTEL/SWAYAM*	3	3	-	-
5.	PDSCT112	MOOCs/NPTEL/SWAYAM*	3	3	-	-
6.	PDSCT125	Internship/Lab	2	-	-	2
<b>Total</b>			<b>20</b>	<b>15</b>	<b>0</b>	<b>5</b>
S.No	Course Code	Title of the Course	Total Credits	Credits Distribution		
				L*	T*	P*
<b>Semester– II</b>						
1.	PDSCT201	Semiconductors Devices Modeling and Simulation	4	3	0	1
2.	PDSCT202	Vacuum Technology & Process Application	4	3	0	1
3.	PDSCT211	MOOC/NPTEL/SWAYAM*	3	3	-	-
4.	PDSCT212	MOOC/NPTEL/SWAYAM*	3	3	-	-
5.	PDSCT228	#Project Work /Dissertation	6	-	-	6
<b>Total</b>			<b>20</b>	<b>12</b>	<b>0</b>	<b>8</b>

\*L: Lectures, \*T: Tutorials, \*P: Practical

\*: **Appropriate online Content available recommended by dept at the time of enrollment**

#: Project Work is compulsory and have to submit to the department one week before second semester examination. Department faculty will allot a supervisor to each student at the end of first semester.

**Note:** 1. MOOCs are chosen by the student based on the availability of the courses offered on SWAYAM & other related platforms as suggested/recommended by the Department.

2. The desired changes may be made by the Department in the programme structure as and when necessary with the prior approval of the BOS.

## Credit Distribution

Semester	Total Credits
Semester-I	20
Semester-II	20
<b>Total</b>	<b>40</b>

### Important Information to Students

#### 1. Eligibility:

- a. Students pursuing/completed PG/Ph.D. programmes in any other educational institution . with B.Sc in Computer Science/Mathematics/Physics/Electronics or any B.Tech/MTech or MCA or M.Sc in Computer Science/Mathematics/Physics/Electronics.
  - b. CUAP/Non CUAP students pursuing any PG/PhD Programmes can enroll for PG Diploma Programmes offered by the University
  - c. Non CUAP students shall have to appear for an Entrance Examination conducted by the University
  - d. A student can enroll for as many PG Diploma Programmes as he/she wishes to
2. The minimum duration for completion of any Postgraduate Diploma Programme is two semesters (one academic year).
  3. Maximum duration of completion of programme is two years.
  4. A student should have minimum 75% attendance in classes, seminars, practical/ lab in each course of study without which he/she will not be allowed for the Semester -end examination.
  5. All theory courses in the programme shall have Continuous Internal Assessment (CIA) component of 40 marks and a Semester-end component of 60 marks. The minimum pass marks for a course is 50%.
  6. The student has to appear 3 CIA tests of 15 marks each per semester in each course from which the best 2 performances shall be considered for the purpose of calculating the marks. A record of the continuous assessment is maintained by the department. The remaining 10 marks are awarded based on participation and performance in:
    - Assignments
    - Class presentations
    - Seminars
    - Quizzes
  7. A student should pass separately in both CIA and the Semester-end Examination.
  8. Semester-end examination shall consist of objective type questions, descriptive type questions, short answer questions and case studies or any others.
  9. A student failing to secure the minimum pass marks in the CIA is not allowed to take the semester-end examination of that course. She/He has to redo the course by attending special classes for that course and get the pass percentage in the internal tests to become eligible to take the semester-end examination.
  10. Students failing a course due to lack of attendance should redo the course.

## SEMESTER-I

Course Code: <b>PDSCT101</b> Core/ Elective: <b>Core</b> No. of Credits: <b>4</b> No. of Hours: <b>75</b>	<b>Fundamentals of Semiconductor Devices</b>
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### Course Objectives

- Introduce the fundamental physics and properties of semiconductor materials and devices.
- Explain carrier behavior, pn-junction electrostatics, and device operation principles.
- Explore MOS capacitor and MOSFET structures, characteristics, and performance metrics.
- Discuss technology scaling, advanced device types, and optoelectronic semiconductor devices.

### Learning Outcomes

Students will be able to:

- Describe semiconductor material properties, energy bands, and carrier dynamics.
- Analyze pn-junction behavior under different bias conditions and understand diode characteristics.
- Explain MOS capacitor operation, MOSFET device physics, and key performance parameters.
- Understand the effects of technology scaling and short channel phenomena in modern transistors.
- Recognize the working principles of optoelectronic devices such as photodetectors, LEDs, and diode lasers.

### Course Outline:

#### UNIT-I

**15 hrs**

Semiconductors in daily life, semiconducting material properties, energy levels in atoms, energy band formation, bandgap and material classification, electrons and holes, effective mass Carrier properties – intrinsic carrier density, Fermi level, donor and acceptor impurities, Fermi level in extrinsic semiconductors, temperature dependence of carrier density, generation and recombination of carriers Thermal motion of carriers, carriers under electric field, mobility and drift current, diffusion of carriers, general expression for current in a semiconductor, energy bands under electric fields.

**UNIT-II****15 hrs**

*pn* junction electrostatics, fixed and free charge, depletion approximation, electric field at the junction, built-in potential, step junction vs linearly graded junction, energy band diagram of a PN Junction and quasi-Fermi levels *pn* junction under applied bias, minority carrier injection and spatial variation in depletion and quasi-neutral regions, band-bending under applied bias, ideal diode equation Diode non-idealities, breakdown, depletion and diffusion capacitance, *p-i-n* Diode, Metal Semiconductor Junctions.

**UNIT-III****15 hrs**

Ideal MOS capacitor structure, Qualitative analysis of field effect, block charge, electric field and potential diagrams, energy band diagrams, Accumulation and inversion regimes, Gate voltage drop across a MOS device Threshold voltage of a MOS device, Capacitance-Voltage(CV) measurements, HFCV and LFCV of a MOS capacitor.

**UNIT-IV****15 hrs**

Non-idealities in a MOS capacitor – work function difference and flatband voltage, tunneling over gate barrier and leakage current, high- $k$  gate dielectrics Long Channel MOSFETs, energy band diagram and qualitative understanding of MOSFET operation,  $I_D$ -  $V_D$  and  $I_D$ - $V_G$  relationships, square law theory of MOSFET, sub-threshold slope, performance metrics of a MOSFET.

**UNIT-V****15 hrs**

Technology scaling and Moore's law, qualitative understanding of Short channel effects – velocity saturation, channel length modulation, drain induced barrier lowering (DIBL), differences in IV characteristics of long and short channel MOSFETs, overview of modern FETs (FinFETs, tunnel FETs and nanowire transistors) Optoelectronic devices in daily life, III-V Semiconductors, direct and indirect bandgaps, optical absorption, *pin* photodetectors, solar cells, open circuit voltage and short circuit current Light emitting devices – Heterostructures, LEDs and their luminescent efficiency, double heterostructure and population inversion, diode lasers, LI characteristics and threshold current.

**References:**

1. Solid State Electronic Devices, by Ben Streetman and Sanjay Banerjee, Prentice Hall.
2. Introduction to Semiconductor Materials and Devices, by M. S. Tyagi, Wiley Publications.

Course Code: <b>PDSCT102</b> Core/ Elective: <b>Core</b> No. of Credits: <b>4</b> No. of Hours: <b>75</b>	<b>Fundamentals of Power Electronics</b>
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### Course Objectives

- Introduce power electronic devices including transistors, IGBTs, and thyristors.
- Explain the construction, operation, and characteristics of various thyristor family devices.
- Teach different methods of triggering and controlling SCRs and their protection circuits.
- Explore power control techniques such as phase control and rectifier configurations with practical applications.

### Learning Outcomes

Students will be able to:

- Understand the working principles and characteristics of power transistors, IGBTs, SCRs, and other thyristors.
- Identify and describe various thyristor devices and their triggering methods.
- Design and analyze SCR triggering and turn-off circuits.
- Explain phase control techniques and analyze different rectifier circuits under various loads.
- Apply power electronics devices in real-world applications like battery chargers, alarm systems, and speed controllers.

### Course Outline:

#### UNIT-I

**15 hrs**

Power electronic devices, Power transistor: construction, working principle, V-I characteristics and uses. IGBT: Construction, working principle, V-I characteristics and uses. Concept of single electron transistor (SET) - aspects of Nano- technology. SCR: construction, two transistor analogy, types, working and characteristics. SCR mounting and cooling.

#### UNIT-II

**15 hrs**

Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC, Thyristor family devices: symbol, construction, operating principle and V-I characteristics. Protection circuits: over- voltage, over-current, Snubber, Crowbar SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering. Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

**UNIT-III****15 hrs**

SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit. Pulse transformer and opto-coupler based triggering. SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C- Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E- External pulse commutation, Class F- Line or natural commutation.

**UNIT-IV****15 hrs**

Phase control: firing angle, conduction angle. Single phase half controlled, full controlled and midpoint- controlled rectifier with R, RL load: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode.

**UNIT-V****15 hrs**

Different configurations of bridge-controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm. Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control / fan speed control TRIAC.

**References:**

1. John G. Kassakian, Martin F. Schlecht and George C. Verghese, "Principles of Power Electronics," Pearson, 2010.
2. P. Wood, Switching Power Converters, New York: Van Nostrand Reinhold Inc., 1981.
3. Ned Mohan, T. Undeland, and W. Riobbins, "Power Electronics: Converters, Applications and Design," Wiley-India, 2011.
4. J. W. Motto, "Introduction to solid state power electronics" POWEREX Semiconductor Division, 1977.
5. R.W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer, 2001.
6. S. B. Dewan and A. Straughen, "Power Semiconductor Circuits", Wiley, 1975.
7. J. Vithayathil, "Power Electronics: Principles and Application", McGraw-Hill Series, International Edition, 1995.
8. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, Fifth Edition, 1998.

Course Code: <b>PDSCT103</b> Core/ Elective: <b>Core</b> No. of Credits: <b>4</b> No. of Hours: <b>75</b>	<b>Introduction to Digital System Design</b>
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**Course Objectives**

- Introduce number systems, binary arithmetic, and logic gate fundamentals.
- Teach Boolean algebra and logic function simplification techniques.
- Explore combinational and sequential logic components such as multiplexers, flip-flops, and counters.
- Provide an understanding of data conversion techniques and digital logic families.

**Learning Outcomes**

Students will be able to:

- Perform binary arithmetic and represent data using binary codes.
- Apply Boolean algebra to simplify digital logic functions.
- Design and analyze arithmetic circuits, encoders, decoders, and comparators.
- Understand and implement flip-flops, latches, counters, and shift registers.
- Explain the working of DACs, ADCs, and various logic families used in digital systems.

**Course Outline:**

<b>UNIT-I</b>	<b>15 hrs</b>
Number Systems, Binary Arithmetic, Binary Codes and Logic gates, Boolean Algebra and Standard representation of Logic functions.	
<b>UNIT-II</b>	<b>15 hrs</b>
Simplification of logic functions using reduction techniques.	
<b>UNIT-III</b>	<b>15 hrs</b>
Arithmetic Circuits and Magnitude Comparator, Code converters, Encoder and Decoders.	
<b>UNIT-IV</b>	<b>15 hrs</b>
Multiplexer and Demultiplexer, Flip Flop and Latches, Counters.	
<b>UNIT-V</b>	<b>15 hrs</b>
Shift register, Digital to Analog converter and Analog to Digital converter, Logic Families.	

**References:**

1. Digital Design: with an introduction to Verilog HDL by M. Morris Mano and Michael D. Ciletti, 5th Edition, Pearson Education, 2013.
2. Advanced Digital Design with the Verilog HDL by Michael D Ciletti, 2nd edition, Pearson education, 2017.
3. Fundamentals of Logic Design by Roth and Kinney. 7th edition, Cengage learning, 2014
4. Digital system design using verilog by Roth, John and Lee, 1st edition, Cengage learning, 2016.

## SEMESTER-II

Course Code: <b>PDSCT201</b> Core/ Elective: <b>Core</b> No. of Credits : <b>4</b> No. of Hours: <b>75</b>	<b>Semiconductor Device Modeling and Simulation</b>
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### Course Objectives

- Introduce number systems, binary arithmetic, and Boolean algebra used in digital system modeling.
- Develop understanding of logic simplification techniques and combinational circuit design.
- Explore implementation of logic functions using ROM, PLAs, PALs, and other programmable devices.
- Understand sequential circuits including flip-flops, counters, shift registers, and memory units.

### Learning Outcomes

Students will be able to:

- Perform number base conversions and arithmetic operations in binary and BCD formats.
- Apply Boolean algebra and Karnaugh maps to simplify logic functions.
- Design and implement combinational circuits such as adders, encoders, and multiplexers.
- Use ROM, PLAs, and PALs to realize logic functions.
- Analyze and design sequential circuits including various types of flip-flops, counters, and memory elements.

### Course Outline:

#### UNIT-I

**15 hrs**

Number System: Weighted and Unweighted Codes, Binary, Octal, and Hexadecimal numbers; Fixed- and Floating-Point Number Representations, number base conversion, Complements.

#### UNIT-II

**15 hrs**

Binary Arithmetic: Addition, Subtraction, Multiplication and Division, BCD Code. Introduction to Boolean algebra, laws of Boolean algebra, logic gates, universal logic gates, POS and SOP notations, Canonical logic forms.

#### UNIT-III

**15 hrs**

Simplification of Boolean Functions: Laws of Boolean algebra and K-Maps, Tabulation Method. Combinational Circuits: Design Procedure of Combinational Circuits, Adders, Subtractors, Code Converters, Magnitude Comparator.

**UNIT-IV****15 hrs**

Combinational Circuits: Encoder, Decoder, Multiplexer, Demultiplexer and its Applications. ROM, PLAs, PALs etc. and implementation of Boolean function through these ROM, PLAs & PAL.

**UNIT-V****15 hrs**

Sequential Circuits: Flip-Flops: SR, D, JK, T, Master/Slave F/F, Edge-triggered F/F, Excitation Tables; Registers, Counters: synchronous and asynchronous, Design of Counters, Shift Registers, RAM.

**References:**

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
3. D. Vasilevski, S.M. Goodnick, G Klimeck, "Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation," CRC Press 2010.
4. Selberherr Siegfried, "Analysis and Simulation of Semiconductor Devices", 1984

Course Code: <b>PDSCT202</b> Core/ Elective: <b>Core</b> No. of Credits: <b>4</b> No. of Hours: <b>75</b>	<b>Vacuum Technology &amp; Process Application</b>
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### Course Objectives

- Introduce the fundamentals and history of vacuum technology and its physical principles.
- Explain vacuum generation methods and various types of vacuum pumps and components.
- Understand gas flow behavior under low pressure and calculate conductance and pumping speed.
- Explore industrial and scientific applications of vacuum systems and their design considerations.

### Learning Outcomes

Students will be able to:

- Describe the principles of vacuum physics and classify vacuum regions.
- Understand the operation of different vacuum pumps and measurement systems.
- Analyze gas flow in vacuum systems and perform conductance and pump-down calculations.
- Identify and explain vacuum applications in industries like pharmaceuticals, food, packaging, wood, and healthcare.
- Design basic vacuum systems and troubleshoot performance issues in practical setups.

### Course Outline:

<b>UNIT-I</b>	<b>15 hrs</b>
Introduction to Vacuum, Natural vacuum, History of Vacuum Technology, Kinetic theory of gases, Physical Parameters of Vacuum and Regions of Vacuum, Vacuum Process Applications.	
<b>UNIT-II</b>	<b>15 hrs</b>
Pumping Speed and Throughput Concepts, Rotary Vacuum Pump, Diffusion Pump, Roots Vacuum Pump, Rotary Piston Pump.	
<b>UNIT-III</b>	<b>15 hrs</b>
Measurement of Vacuum, Scroll Pump, Sorption Concepts and Pumps, Ion Pumping-Sputter Ion Pump, Cryopumps, Vacuum Materials, Valves, Components, Couplings & Chambers.	
<b>UNIT-IV</b>	<b>15 hrs</b>
Gas Flow at low pressure, Conductance & Effective Pumping Speed concepts, Conductance Calculations in Viscous Flow Region, Molecular Flow, Fluid Flow (Viscous/Molecular) in Vacuum Systems, conductance and pump down calculations.	

**UNIT-V****15 hrs**

Vacuum Processes in Chemical and Pharmaceutical Industries, Vacuum for Food processing, Vacuum Technology in the Packing Industry, Vacuum in wood Industry, Vacuum systems for Medical and Dental Applications, Design and Trouble Shooting aspects of Vacuum systems, Process Applications of Vacuum Technology.

**References:**

1. Vacuum Science & Technology- VV Rao, KL Chopra & TB Ghosh
2. Vacuum Technology and Process Applications by V V Rao
3. Modern Vacuum Physics by Austin Chambers
4. High Vacuum Technology: A Practical Guide by M.H.Hablanian

Course Code: <b>PDSCT228</b> Core/ Elective: <b>Core</b> No. of Credits: <b>6</b> No. of Hours: <b>One Semester</b>	<b>Project Work / Dissertation</b>
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## Objectives

Implement some of the existing techniques and develop new algorithms, models, or tools in semiconductor device design, modeling, simulation, or manufacturing, to produce meaningful research outputs. Apply the knowledge of Semiconductor Technology, VLSI Design, Packaging, and Fabrication for solving real-world design and application problems. Identify suitable research problems through a comprehensive literature survey from standard research articles and explore the state-of-the-art methodologies. Use relevant EDA tools, simulation software, and fabrication-related frameworks to demonstrate results with practical significance and generate necessary research components.

Student is required to submit a detailed project report on the selected topic for their project as per the guidelines decided by the department. The project work is to be evaluated through presentations and viva-voce during the semester and final evaluation will be done at the end of the semester as per the guidelines decided by the department from time to time.

However, candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.