INTEGRATED CIRCUIT DESIGN

Module I

The CMOS Inverters and CMOS Logic Gates – the Static View:

Introduction to CMOS Inverter, Introduction to Static CMOS Design, The Dynamic Behavior, Power, Energy, and Energy-Delay, Complementary CMOS, Pass-Transistor Logic, Transmission gates, Technology Scaling and its Impact on the Inverter Metrics

Dynamic CMOS Logic, Timing Metrics:

Dynamic CMOS Design, CMOS Logic Design Perspectives, Timing Metrics: Timing Metrics for Sequential Circuits, Classification of Memory Elements

Module-II

Basic Building Blocks:

Inverter with Active Load, Cascode, Cascode with Cascode Load, Source Follower, Threshold Independent Level Shift, Improved Output Stages

Current and Voltage Sources:

Current Mirrors, Current References, Voltage Biasing, Voltage References

CMOS Operational Amplifiers:

General Issues, Performance Characteristics, Basic Architecture, Two Stages Amplifier, Frequency Response and Compensation, Slew Rate

Module-III

Overview of Mixed-Signal Testing – Mixed-signal circuits, Test and diagnostic equipments, Mixed-signal testing challenges, The Test Specification Process – Device datasheets, Generation of test plan, Components of a test program, DC and Parametric Measurements – Continuity, Leakage currents, Power supply currents, DC references and regulators, Impedance measurements, DC offset measurements, DC gain measurements, DC power supply rejection ratio, DC common-mode rejection ratio, Comparator DC tests, Voltage search techniques, DC tests for digital circuits, Measurement Accuracy – Terminology, Calibration and checkers, Dealing with measurement errors, Basic data analysis, Tester Hardware – Mixed-signal tester overview, DC resources, Digital subsystem, AC source and measurement, Time measurement system, Computing hardware.

IDDQ Testing , Design for Testability , Built-In Self-Test , Boundary Scan , Analog Test Bus , System Test and Core Test

Module-IV

Overview of LDMOS, Power MOS, Floating Gate MOS

Emerging Technology: Overview of HEMT, FinFET, Organic FET (OFET), Graphene nano-ribbon field effect transistor (GNRFET).

IC Design for Internet of Everything (IoE): Overview of Analog IC, Digital & Memory IC, Mixed-Signal IC, RF/MM-Wave/Terahertz IC

Text books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, *Digital Integrated Circuits – A Design Perspective*, 2nd edn., Pearson Education, 2003. ISBN: 8178089912.
2. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw-Hill, 2001. ISBN: 0-07-238032-2.
3. Mark Burns and Gordon W. Roberts, *An Introduction to Mixed-Signal IC Test and Measurement*, Oxford University Press, 2001, ISBN: ISBN-10: 0195699262, ISBN-13: 9780195699265
4. Millimetre-Wave Integrator Circuits, by Eoin Carey , Sverre Lidholn, Springer Pub(Chapter-I)
5. Design of C-MOS mm-Wave & Terahertz IC with Metamaterials, by Hao Yu, Yang Shang, CRC Press.
6. Fin-FET modelling for IC Simulation nad Design, 1st edition, by Chauhan & Lu & Sriramkumar & Khandelwal & Darte & Payradosi & Nikhejad & Hu., 2015, Elsevier pub
7. HEMTs & HBTs, by Fazl Ali, Aditya KumarGupta
8. Organic Field – Effect- Transitors , by Zhenan Bao, Jasm Locklin, CRC press
9. Carbon –nano tube & Graphene Nanoribbon Interconnect, by Debiprasad Das , Hafizur Rahaman, CRC Press
10. Research papers in Specific area

Recommended Readings:

1. K. Eshraghian, and N.H.E. Weste, *Principles of CMOS VLSI Design – a Systems Perspective*, 2nd edn., Addison Wesley, 1993.
2. John P. Uyemura, *CMOS Logic Circuit Design*, Springer (Kluwer Academic Publishers), 2001.
3. Ken Martin, *Digital Integrated Circuit Design*, Oxford University Press, 2000.
4. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, *Analysis and Design of Analog Integrated Circuit*, John Wiley & Sons, Inc., 4th edn., 2000. ISBN: 0-471-32168-0.
5. Phillip E. Allen and Douglas R. Holberg, *CMOS Analog Circuit Design*, Oxford University Press, 2nd edn., 2002. ISBN: 0-19-511644-5
6. Bapiraju Vinnakota, *Analog and Mixed-Signal Test*, Prentice Hall PTR, 1998, ISBN-10: 0137863101, ISBN-13: 978-0137863105