Detailed Syllabus
Lecture-wise Breakup

Course Code	**17M21EC112**	**Semester: Odd**	**Semester** I **Session** 2020-21 **Month from** July **to** December
Course Name	**Digital Integrated Circuit Design**		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Shamim Akhter
	Teacher(s) (Alphabetically)	

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to digital IC Design	Review of digital logic gate design and digital integrated circuit design, MOS transistor technology and operation.	6
2.	MOS inverter circuits	Analytical modeling of CMOS inverter (DC and Transient): Noise margins, power estimation, delay calculations, sizing of inverter chain.	7
3.	Static MOS gate circuits	Analytical modeling of CMOS gate circuits (DC and Transient), complex CMOS gates, Multiplexer circuits, Flip flop and latches	7
4.	High speed CMOS logic design	Load capacitance calculations, improved delay calculations with input slope, optimizing paths with logical effort.	11
5.	Transfer gate and dynamic logic design	Pass Transistor, charge sharing, sources of charge loss, TG logic, Dynamic D-Latch	6
6.	Introduction to semiconductor memory design.	MOS Decoders, Static RAM cell design, SRAM column I/o circuitry.	5
		Total number of Lectures	**42**

Recommended Reading material: (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)

1.	J. M. Rabaey, A. Chandrakasan, B. Nikolic: Digital Integrated Circuit: A design perspective, 2nd Edition, Pearson Education, Delhi-2005
2.	Weste, Neil HE, and David Money Harris. CMOS VLSI Design. Pearson/Addison Wesley, 2010. Geiger,
3.	J. M. Rabaey., and Massoud Pedram, eds. Low power design methodologies. Vol. 336. Springer Science & Business Media, 2012.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**20M51EC122**	**Semester:** ODD **(specify Odd/Even)**	**Semester: I Session: 2020-2021 Month from: June - Dec**
Course Name	Fundamentals of semiconductor Devices		
Credits	4	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Akansha Bansal
	Teacher(s) (Alphabetically)	Dr. Akansha Bansal

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	To understand the basics of semiconductor band diagram, carrier transport	Understanding Level (C2)
CO2	To understand the working of basic semiconductor diodes and its application	Understanding Level (C2)
CO3	Analyze the critical parameters and characteristics of the standard MOSFET	Analyzing Level (C3)
CO4	Applying the basic semiconductor knowledge to design special application devices	Applying Level (C4)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Basics of semiconductor physics	Introduction to semiconductors, energy bands. Fundamentals of band structure and Fermi-Dirac distribution, Density of states	5
2.	Carrier concentration and carrier transport	Intrinsic and equilibrium carrier concentration, High doping effects, incomplete ionization, Drift diffusion and continuity equations	6
3.	P-N junctions & its applications	PN junction under equilibrium and bias, generation recombination, Applications of PN junction and its breakdown	5
4.	Metal semiconductor Junction	Introduction to Schottky junction, Schottky junction under equilibrium and bias.	4
5.	Metal oxide semiconductor capacitor	MOS: Introduction, Ideal MOS system-flatband and threshold voltage, CV high and low frequencies	4
6.	MOSFET	MOSFET: Introduction, Gradual channel approximation, substrate bias effedt and short channel effects in MOSFET	7
7.	Compound semiconductors	Basics of heterojunctions, band diagram, Heterojunction transistors	5
8.	Optoelectronics devices	Basics of solar cells and LED, recombination, Solar cell: Shockley Quiesser Limit, LED: light extraction and design issues	6

	Total number of Lectures	42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Sanjay K. Bannerjee, Solid State Electronic Devices, Pearsons 2014. (Text book)
2.	Donald A. Neamen, "An Introduction to Semiconductor Devices", McGraw Hill, 2005 (Reference book)
3.	David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 2015 (Reference book)

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M22EC113	**Semester:** **(specify Odd/Even)**	**Semester: I Session: 2020-21** **Month: July-Dec**
Course Name	HDL Based Digital Design		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Shruti Kalra
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Recall the basics combinational and sequential circuits	Remembering Level (C1)
CO2	Understand the concepts of Verilog hardware description language and distinguish between good and bad coding practices	Understanding Level (C2)
CO3	Learn to model synchronous and Asynchronous digital circuits	Applying Level (C3)
CO4	Fault analysis and case studies on complex digital circuits	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction to Verilog	Overview of Digital Design with Verilog HDL, Hierarchical Modeling Concepts, Modules and Ports, Gate-Level Modeling, Dataflow Modeling, Behavioral Modeling, Tasks and Functions, Useful Modeling Techniques	9
2.	Advanced topics in Verilog	Timing and Delays, Switch-Level Modeling, User-Defined Primitives, Programming Language Interface, Logic Synthesis with Verilog HDL, modeling memory and register banks, introduction to the concept of pipelining.	9
3.	Synchronous Finite State Machine	Flip-Flops, Triggering of Flip-Flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Flip-Flops Excitation Tables, Design Procedure	9
4.	Asynchronous Finite State Machines	Asynchronous Analysis, Design of Asynchronous Machines, Flow table realization, reduction, state assignments and design, Cycle and race analysis. Hazards, Essential Hazards, and its removal	10
5.	Fault Analysis	s-a-0, s-a-1 fault analysis using path sensitization method, Boolean Difference Method	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance, Performance. Assignment/Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Monk S. Programming FPGAs: Getting Started with Verilog. McGraw Hill Professional; 2016.
2.	Li Y. Computer principles and design in Verilog HDL. John Wiley & Sons; 2015.
3.	Ciletti M. Advanced digital design with the Verilog HDL. Prentice hall; 2009.
4.	Sutherland S. The Verilog PLI Handbook: a user's guide and comprehensive reference on the Verilog programming language interface. Springer Science & Business Media; 2013.

Detailed Syllabus

Lecture-wise Breakup

Subject Code		**Semester (specify Odd/Even)**	**Semester Session – ODD 2021** **Month from: July to December**
Subject Name	Modeling and Simulation of Semiconductor Devices		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	
	Teacher(s) (Alphabetically)	

Course Objectives:

The aim of the "*Modeling and Simulation of Semiconductor Devices"* course is to understand the performance of modern electronic devices using TCAD and Compact Modeling tools. Principles of the DC, AC, RF, Noise, Large-Signal, Temperature, and Optoelectronic modeling of semiconductor devices are explained and their applications to modern devices (CMOS, FinFET, 1D-Photonic Crystal based devices such as Omnidirectional Dielectric Mirrors, Antireflection Coatings and Polarizing Beam Splitters) are analyzed

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
CO1	Develop an understanding of semiconductor physics, different modeling techniques and models.	Understanding (Level II)
CO2	Perform mathematical modeling for different transport equations and given boundary conditions.	Applying (Level III)
CO3	Analyze the electrical performances of Semiconductor devices.	Analyzing (Level IV)
CO4	Analyze the electrical performances of Optical and Photonic devices.	Analyzing (Level IV)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Introduction	Review of semiconductor electronics, band model for solids, Distinguish among activities of analysis, modeling, simulation and design, Transform the equivalent circuit form of a device model into a mathematical form, and vice-versa, Semi-classical Bulk Transport – Qualitative Model	8
2.	Fundamentals of Models	Fundamental equations for semiconductor devices: current equations, Poisson equation, study cases, continuity equations, Semi-classical Bulk Transport – EM field and Transport Equations. Drift-Diffusion Transport Model – Equations, Boundary Conditions, Mobility and Generation / Recombination	12
3.	Modeling and design strategy of MOSFET	MOSFET: basic theories and models, MOSFET parameters, Body effects, transconductance, speed of response, channel-length modulation, MOSFET design, control of the threshold voltage. MOSFET Model: Structure and Characteristics, Qualitative Model, Equations, Boundary Conditions and Approximations, Surface Potential based and Threshold based solutions, Parameter Extraction	10
4.	Modeling and design strategy of Photonic Devices	Introduction to optical and photonic devices, Electromagnetic waves in homogeneous material, Waves scattering on interfaces and thin slabs, light cone, dispersion relation, Modeling of one-dimensional photonic crystal: physical origin of gaps,lattice defects, bound states. Photonic crystal slabs and Bloch surface wave based design.	10
5.	Recent Trends	Introduction to recent trends in semiconductor devices	2
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading(Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	Sophocles J. Orfanidis, Electromagnetic Waves and Antennas, Rutgers University, 2016
2.	Arora, N., MOSFET Models for VLSI Circuit Simulation, Springer-Verlag, 1993
3.	Selberherr, S., Analysis and Simulation of Semiconductor Devices, Springer-Verlag, 1984
4.	IEEE, Elsevier, and IOPscience Journals

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17M21EC112	**Semester: ODD**	**Semester: I Session:2020-2021** **Month from** July **to** December
Subject Name	Photonics Materials & Devices for Communications		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Amit Kumar Goyal
	Teacher(s) (Alphabetically)	Dr. Amit Kumar Goyal

COURSE OUTCOMES-At the completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Develop an understanding of photonic components and optical fiber technology.	Understanding Level (C2)
CO2	Design and analyze different types of Photonic/Nano-photonic devices and components.	Applying Level (C3)
CO3	Classify the material system/technologiesalong with their fabrication processes to design efficient photonic devices for communication.	Analyzing Level (C4)
CO4	Analytically evaluate the various photonic devices.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Basics of Photonics, Optical fibers and	Photonics, integrated photonics and their brief history, Basic photonic technologies and components, Brief introduction to Maxwell's equations, wave equation, Electromagnetic waves at different dielectric interfaces. Overview of Optical fibers, types (step-index and graded index), single-mode and multi-mode along with their condition, birefringent	10

		fiber, numerical aperture,Optical fiber communications, Dispersion and scattering losses in fiber, budget analysis.	
2.	Optical waveguides and Photonic Devices	Optical waveguides classification, Guided modes in optical waveguides, Dispersion of guided modes, Single-mode 3-D optical waveguides. Basic integrated-optic devices: Optical power splitter, Directional coupler, thermo-optic switches, Mach-Zehnder interferometer, Arrayed Waveguide Grating (AWG)-based MUX/DEMUX, Add-drop multiplexer, Design of photonic devices: Beam Propagation Method and Marcatili's Method.	10
3.	Fundamental of Nano-Photonic Devices and Components	Nano-photonics: Photonic crystal (PhC) technology, PhC waveguide, PhC resonator, PhC MUX/DEMUX, PhC Filters, PhC fibers, Nano-wires, Packaging of photonic devices. Recent studies on PhC based devices for communication applications.	6
4.	Photonic Materials and Fabrication Technologies	Photonic materials, selection of materials like silicon, silica, Lithium Niobate, Compound Semiconductor and Polymers. Fabrication and process techniques like Lithography, Deposition, and Diffusion etc. Parameter measurement and techniques, recent studies on photonic materials.	10
5.	Coupled-mode Theory and Devices	Basic concepts of coupled mode theory, Mode coupling: co-directional and contra-directional, Mode coupling in corrugated waveguides, Short-period and long-period gratings in optical fibers and optical waveguides, Properties of short-period and long-period gratings, Application of gratings in communication, and Recent trends.	8
		Total number of Lectures	**44**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25

Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Gerd Keiser, Optical Fiber Communications, 3rd Edition, McGraw-Hill International edition, 2000.
2.	John M. Senior, Optical Fiber Communications, 2nd Edition, PHI, 2002.
3.	H Nishihara, M Haruna and T Suhara, Optical integrated Circuits, McGraw-hill, 1989.
4.	D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005.
5.	C. R. Pollock and M. Lip Son, Integrated Photonics, Kluwer Pub., 2003.
6.	T. Tamir, (ed), Guided-wave optoelectronics, (2nd edition), Springer-Verlag, 1990.
7.	Clifford Pollock, Fundamentals of Optoelectronics, Richard Irwin Inc., Chicago, 1995.
8.	Journal articles i.e. IEEE, Springer, IOPscience, Elsevier and Video lectures from nanohub, NPTEL, MIT video lectures
9.	https://nptel.ac.in/courses/117/108/117108142/

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M12EC124	**Semester:** Odd **(specify Odd/Even)**	**Semester:** Ist **Session:** 2020-21 **Month from:** July to Dec
Course Name	Reliability Engineering		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Ruby Beniwal
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Recall the use of different electronic circuits and networks used in Engineering.	Remembering Level (C1)
CO2	Illustrate various mathematical model with engineering knowledge and specialist techniques to prevent or to reduce the likelihood or frequency of failures	Understanding Level (C2)
CO3	Apply reliability methods on time independent and time dependent failure models	Applying Level (C3)
CO4	Optimize reliability for time independent and time dependent failure models through various testing methods	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction of Reliability and Reliability concept	Reliability Concepts, Definition, Importance and Various Measures. Reliability Mathematics: Probability, Distributions reliability Vs quality-reliability function-MTTF – hazard constant failure rate model – time dependent failure models	8
2.	Markov Process and Reliability model	Markov Processes, Probability Plots. Reliability Models: Block Diagrams, Graphs, Fault Trees, BDD, Markov, Petri Nets, Multistates, degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models.	8
3.	Reliability Data Analysis	Multistates, Flow Limited and Statistical. Reliability Analysis using different Models Failure Data Analysis. Reliability design process – system effectiveness – economic analysis and life cycle	8
4.	Reliability Engineering	Weibull distribution – normal distribution	10

		– the lognormal distribution. Serial configuration – parallel configuration – combined series parallel systems – system structure function, minimal cuts and minimal paths – Markov analysis – load sharing systems, standby system, sectioned solids.	
5.	Optimization of System Reliability	Reliability Optimization, Testing, Demonstration and design. Maintainability and Availability Concepts, Measures and Analysis. Optimization techniques for system reliability with redundancy	8
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance, Performance. Assignment/Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw-Hill, 2017.
2.	Patrick D T o'connor, "Practical Reliability Engineringt", John-Wiley and Sons inc, 2011.
3.	Balagurusawy ,"Reliability Engineering", McGraw Hill, 2002
4.	Mangey Ram and J. Paulo Davim," Recent Advances in System Reliability Engineering" Academic Press 2019