Course Code	ECE517
Course Name	Introduction to Nanoelectronics
Credits	4
Course Offered to	UG/PG
Course Description	Nanoelectronics is an interdisciplinary area of research which has a huge potential and is currently attracting a great deal of attention. The objective of this course is to understand the basic principles that govern the operation and electrical characteristics of nanoelectronic devices and become familiar with the recent research being undertaken in nanoelectronics.

Pre-requisites

Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite (Other)
Basic understanding of P-N junction and MOSFET	Fundamentals of Solid-State Devices	

Post Conditions

CO1	CO2	CO3	CO4
Clearly explains distinct phenomena that are important in nanoelectronic devices.	Is able to describe the operating principles, merits, demerits and challenges of some of the futuristic nanoelectronic devices.	Is able to compute a given parameter or physical quantity for a nanoelectronic device by applying appropriate equations or formula.	Is able to describe the challenges of scaling of conventional MOSFETs and possible solutions.

Weekly Lecture Plan

Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial
1	"bottom-up" approach to build devices, trends and ITRS perspective	CO1, CO2, CO4	Choosing Topic for Seminar
2	Particle, Basic Postulates, Wave Function, Schrodinger's equation, Expectation Value, Particle in a Box, Finite Potential Well,	CO1, CO3	
3	Energy Bands, Density of States, Distribution Functions, Fermi Level, Quantum Well, Quantum Wire, Quantum	CO1, CO3	
4	Transport in Confined Materials, Ballistic Transport	CO1, CO2, CO3	
5	Effects, Limits on Subthreshold Swing and its consequences, Challenges in Scaling	CO3, CO4	Assignment 1
6	Strain, FDSOI MOSFET, FinFETs, III-V Materials	CO3, CO4	
7	2-D Materials: Graphene, Transition Metal Dichalcogenide (TMD)	CO1, CO3	Write-up for Seminar
8	1-D Materials: CNT, Nanowires	CO1, CO3	
9	CNT, Graphene Nanoribbon and Nanowire based FETs	CO1, CO2, CO3	Assignment 2
10	Steep Subthreshold Slope Devices: Tunnel FET, NCFET, IMOS	CO1, CO2, CO3	
11	Nanoelectromechanical Switches (NEMS)	CO1, CO2, CO3	
12	Novel Devices: Single Electron Transistors, Molecular Devices	CO1, CO2, CO3	
13	Summing Up and Presentation	CO1, CO2, CO3, CO4	

Assessment Plan

Type of Evaluation	% Contribution in Grade
Assignment	10
Paper presentation	20
Mid-sem	20
End-sem	50

Resource Material

Type	Title
Reference	Arthur Beiser, "Concepts of Modern Physics"
Reference	S. M. Sze, "Physics of Semiconductor Devices", John Wiley and Sons,
Reference	D. A. Neaman, "Semiconductor Physics and Devices"
Reference	International Technology Roadmap for Semiconductors (ITRS), "Emerging research devices", 2013 edition." http://www.itrs.net, 2013.
Reference	S. Datta, "Quantum Transport: Atom to Transistor", Cambridge University Press, 2nd ed., 2005
Reference	M. Lundstrom, J. Guo: Nanoscale Transistors
Reference	M.S. Dresselhaus, G. Dresselhaus, Ph. Avouris, "Carbon Nanotubes"
Reference	R. Murali, "Graphene Nanoelectronics: From Materials to Circuits"
Internet Resource	Resources at Nanohub (https://nanohub.org/)
Reference	Research Papers (Pointers will be given in the class)
Internet Resource	Information from reliable internet sources