

Unit I Nanolithography

Moore's Laws (1,2,&3) and technology' Roadmap—clean rooms Processing Methods: - Cleaning – Oxidation – Lithography – Etching- – CVD - Diffusion – Ion implantation – metallization – state of the art CMOS architectures Photolithography Overview – Critical Dimension – Overall Resolution – Line-Width – Lithographic Sensitivity and Intrinsic Resist Sensitivity (Photochemical *Quantum Efficiency*)

Unit II Nano meter devices

Material Wave Nanotechnology: Nanofabrication Using a de Broglie Wave-Electron Beam Holography – Atomic Beam Holography- Nanometer Lithography Using Organic Positive/Negative Resists – Sub-10 nm Lithography Using Inorganic Resist – 40 nm-Gate-Length Metal-Oxide-Semiconductor Field-Emitter-Transistors-14 nm Gate-Length Electrically Variable Shallow Junction MOSFETs-Operation of Aluminum-Based Single-Electron Transistors at 100 Kelvins- Room Temperature Operation of a Silicon Single-Electron Transistor

Unit III Nano electronic Devices

Electronic transport in 1,2 and 3 dimensions- Quantum confinement - energy sub bands - Effective mass - Drude conduction - mean free path in 3D - ballistic conduction - phase coherence length - quantized conductance - Buttiker-Landauer formula- electron transport in pn junctions - short channel Nano Transistor –MOSFETs - Advanced MOSFETs - Trigate FETs, FinFETs - CMOS.

Unit IV Nanotechnology in Biomedical and Pharmaceutical Industry

Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis - Reconstructive Intervention and Surgery – Nanorobotics in Surgery – Photodynamic Therapy – Nano sensors in Diagnosis– Neuro-electronic Interfaces – Protein Engineering – Drug delivery – Therapeutic applications -

Unit V Nanotechnology in Chemical Industry

Nano catalyts – Smart materials – Heterogeneous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nano rods, Nanotubes) – Molecular Encapsulation and its applications – Nano porous zeolites – Self-assembled Nano reactors - Organic electroluminescent displays

Unit VI Nanotechnology In Agriculture And Food Technology

Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry - Packaging, Food processing - Food safety and bio-security – Contaminant detection – Smart packaging

Unit VII Nanotechnology in Textiles and Cosmetics

Nanofibre production - Electrospinning – Controlling morphologies of nanofibers – Tissue engineering application – Polymer nanofibers - Nylon-6 nanocomposites from polymerization - Nano-filled polypropylene fibres - Bionics– Swim-suits with shark-skin-effect, Soil repellence, Lotus effect - Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning,

flame retardant finishes) – Modern textiles (Lightweight bulletproof vests and shirts, Colour changing property, Waterproof and Germ proof, Cleaner kids clothes, Wired and Ready to Wear) Cosmetics – Formulation of Gels, Shampoos, Hair-conditioners (Micellar self-assembly and its manipulation) – Sun-screen dispersions for UV protection using Titanium oxide – Color cosmetics

TEXT BOOKS/ REFERENCES:

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2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.
REFERENCES 1. Nabok A., “Organic and Inorganic Nanostructures”, Artech House, 2005

3. Dupas C., Houdy P., Lahmani M., “Nanoscience: Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.

4. Guozhong Cao, *Nanostructures & Nanomaterials Synthesis, Properties G; Z: Applications*, World Scientific Publishing Private, Ltd., Singapore (2004).

5. W.R.Fahrner, *Nanotechnology and Nanoelectronics – Materials, Devices, Measurement Techniques*, Springer-Verlag Berlin, Germany (2006).

6. R. H. J. Hannink and A. J. Hill, *Nanostructure control of materials*, Woodhead Publishing Limited and CRC Press LLC, Cambridge, England (2006).

7. Zheng Cui, *Nanofabrication, Principles, Capabilities and Limits*, Springer Science + business media, New York (2008).

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9. Rainer Waser, —*Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices*||, Wiley-VCH (2003).

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