17VL018 NANO SENSORS AND ITS APPLICATIONS

Hours Per Week :

L	T	P	C
4	-	-	4

Total Hours :

L	T	P
60	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
15	30	-	5	5	-

Course Objectives:

- The importance of nanoscale materials for sensing applications.
- Metallic and semiconductor nanoparticles.
- Organic and inorganic nanotubes and nanowires.
- Optical, mechanical and chemical sensors based on nanomaterials.
- Hybrid nanomaterial-based sensors.

Course Outcomes:

Upon successful completion of this course student should be able to:

- Ability to enhance critical, creative, and innovative thinking.
- Approaches used for characterizing sensors based nanomaterials.
- Approaches used for tailoring nanomaterials for a specific sensing application

SKILLS:

- Ability to apply knowledge on different sensors and design of different technology circuits using sensors.
- Ability to utilize a system approach to design a chip and operational performance

UNIT-1

Sensor Characteristics and Physical Effects : Active and Passive sensors – Static characteristic - Accuracy, offset and linearity – Dynamic characteristics - First and second order sensors – Physical effects involved in signal transduction- Photoelectric effect – Photo dielectric effect – Photoluminescence effect – Electroluminescence effect – Hal effect – Thermoelectric effect – Peizoresistive effect – Piezoelectric effect – Pyroelectric effect –Magnetomechanical effect (magnetostriction) – Magneto resistive effect.

UNIT-2

Nano Based InorganicSensors : Density of states (DOS) – DOS of 3D, 2D, 1D and 0D materials – one dimensional gas sensors: - gas sensing with nanostructured thin films – absorption on surfaces – metal oxide modifications by additives – surface modifications – nano optical sensors – nano mechanical sensors – plasmon resonance sensors with nano particles – AMR, Giant and colossal magneto resistors – magnetic tunneling junctions.

UNIT-3

Organic / Biosensors: Structure of Protein – role of protein in nanotechnology – using protein in nanodevices – antibodies in sensing – antibody in nano particle conjugates – enzymes in sensing – enzyme nanoparticle hybrid sensors – Motor proteins in sensing – transmembrane sensors – Nanosensors based on Nucleotides and DNA – Structure of DNA – DNA decoders and microarrays – DNA protein conjugate based sensors – Bioelectronic sensors – DNA sequencing with nanopores – sensors based on molecules withdendritic architectures – biomagnetic sensors.

UNIT-4

Nano Sensors: Temperature Sensors, Smoke Sensors, Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry Biosensors.

UNIT-5

Applications: Cantilever array sensors - Cantilever sensors for diagnosis of diabetes mellitus - Cantilever sensors for cancer diagnosis - Nanotube based sensors - Nanotube based sensors for DNA detection - Nanotube based sensors for capnography - Nanowire based sensors - Nanowire based electrical detection of single viruses – Nanowire based electrical detection of biomolecules.

TEXT BOOKS

1. Kourosh Kalantar – Zadeh, Benjamin Fry, “Nanotechnology- Enabled Sensors”, Springer,

2. H.Rosemary Taylor, “Data acquisition for sensor systems”, Chapman & Hall, 1997.

REFERENCE BOOKS

1. Jerome Schultz, Milan Mrksich, Sangeeta N. Bhatia, David J. Brady, Antonio J. Ricco, David R. Walt, Charles L. Wilkins, “Biosensing: International Research and Development”, Springer.

2. Ramon Pallas-Areny, John G. Webster, “Sensors and signal conditioning” John Wiley &Sons, 2001.

3. Vijay.K.Varadan, Linfeng Chen, Sivathanupillai, “Nanotechnology Engineering in Nano and Biomedicine”, John Wiley & Sons, 2010.

ACTIVITIES:

- Electrical and Optical Characteristics of InP Nanowires based p-i-n Photodetectors
- Modeling and Simulation of Carbon Nanotube Field Effect Transistors.
- Application of Porous Silicon in Terahertz Technology.