

Department	Physics	
Course	MSc Physics	Effective from the year: 2017
Subject Code : 17 PPS 3E2 Title : Major Elective II: Optoelectronics & Nanoscience	Semester: III	
Hrs/Week:	5	Credit: 5
Objectives	➤ To understand the concepts of Radiometry and Photometry. ➤ To study the design of radiation source, displays and radiation detectors. ➤ To familiarize with the Fiber optics and its applications. ➤ To understand the basics of Nanotechnology and Quantum structure.	

Unit	Content	Hrs
I	RADIOMETRY AND PHOTOMETRY Radiometric and photometric flux - Efficacy - Radiometric and photometric Energy - Radiometric and photometric intensity – Common Radiant Profiles – Relationships between Radiant intensity and flux – Optical transfer function and Numerical aperture – Radiant Incidence and Illuminance – Radiant Sterance and Luminance – Radiant and Luminous Exitance	13
II	RADIATION SOURCES, DISPLAY DEVICES & DETECTORS Light Emitting Diode: Construction – Electrical and Optical Characteristics – Electroluminescent Source: Electroluminescent lighting panel and Display – Vacuum fluorescent Source: Vacuum fluorescent Display – Cathode Ray Tube – Gas discharge Lamps – Plasma Display – Classifications and Characteristics of radiation detectors – Detector Noise – Thermal Detectors: Thermocouple, Bolometer and Pyroelectric detectors – External Photo effect Photoelectric Detectors: Vacuum Photodiode – Photomultiplier – and Micro channel multiplier – Internal Photo effect Photoelectric Detectors: Photoconductors	13
III	OPTICAL FIBRE & ITS APPLICATIONS Optical Fiber versus Metallic Cable – Fiber types and Construction – Model Of Fiber Optic Communications Link – Critical angle – Mode of Propagation and Index profile –Optical Fiber configuration – Acceptance angle, Acceptance cone and Numerical aperture – Losses in optical fiber cables - Optical Fiber Sensor – Multimode optical fiber sensor: Passive and Active – Single mode fiber sensors: Phase modulated sensors – <i>Fiber optic gyroscope</i>	13



Dr.V.Sathyabama
HoD-Physics Department



Dr.P.M.Palanisamy
Principal

V	NANOSCIENCE Moore's laws – Nanotechnology - Quantum structures - Size and dimensionality effects - Fermi electrons - Excitons- Artificial atoms – Nanoclusters – Free clusters- Semiconductor clusters – Nanoclusters on polymers – Limitations – Carbon Nanostructures – Carbon clusters – Carbon Nanotubes – Properties – Applications – Inorganic Nanotubes and Nanowires - Nanostructured ordered / Disordered materials – <i>Nanofiber and Biomedical application</i>	13
V	SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS Synthesis of metal colloids : Chemical methods – Reducing agents- Electrochemical synthesis – Transition metal complex – Synthesis of nanoclusters : Laser induced evaporation – PLD - Chemical methods - Thermolysis – Synthesis of polymer supported clusters : Selection of polymers - Synthesis of Nanotubes : Carbon Nanotubes - Synthesis of Nanowire- Vapor liquid (VLS) solid growth – Oxide assisted growth – Solution Phase - Solvothermal synthesis – XRD – Particle size determination – Spectroscopy (IR & Raman) – Photoluminescence	13
Total contact hours		65

- *Italic font denotes self study*

Text Books

- Endel Uiga, (1995). *Optoelectronics*. Prentice Hall International Editions, New York, (Units I & II).
- WayneTomasi, (1987). *Electronic Communication Systems*. Prentice Hall International Editions, New York, (Unit III).
- Wilson J. Hawkes J.F.B. (1992). *Optoelectronics – An Introduction*. 2nd Edition Prentice Hall, New Delhi, (Unit III).
- Muralidharan V.S. Subramania A. *Nanoscience and Technology*. Ane Books Pvt Ltd – I Edition, New Delhi, (Units IV & V).
- Charles P. Poole, Frank J. Owens, (2011), *Introduction to Nanotechnology*, John Wiley & Sons, New York, (Units IV & V).

Reference Books

- Chin Lin Chen, (1996). *Elements Of Optoelectronics And Fiber Optics*. A Time Mirror higher education Group, inc.company, 1996.
- Guozhong CAO, (2008). *Nano Structures And Nano Materials*. Imperial College plus, London.

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Principal

Programme Code:	MSC	Programme Title:	Master of Science	
Course Code:	18PPS4E3	Title	Batch:	2018-2020
		Major Elective III: Thin film & Nano science	Semester:	IV
Hrs/Week:	5		Credits:	5

Course Objective

- To develop the knowledge about fundamentals of Thin Film and Nano science

Course outcomes

K1	CO1	To understand the concepts of Thin Films
K2	CO2	To study the design of different synthesis methodologies of thin film and nanoscience
K3	CO3	To familiarize with the basics of Nanotechnology and Quantum structure
K4	CO4	To understand the characteristic techniques of various analysis

Syllabus

Unit	Content	Hrs
I	Thin film Nature of thin film, Thermodynamics of nucleation, Film growth, Deposition parameters & grain size, Epitaxy, Incorporation of defects, Impurities in thin films. Deposition Techniques: Physical Vapour deposition: Thermal Evaporation, RF Sputtering, Chemical Vapour deposition: Pyrolysis, Chemical deposition: Chemical Bath deposition.	13
II	Properties of thin films Optical properties: Reflection, Transmission, Absorption, Energy band gap, Transition. Electrical properties: Sheet resistance, Measurement of sheet resistance, Temperature co-efficient of resistance (TCR), Influence of thickness on resistivity, Hall effect and Magneto resistance Application: Integrated circuits	13
III	Nanoscience Introduction - classification of quantum structure –quantum confinement- Nanoscale architecture - Summary of electronic properties of atoms and solids: Free electron model and energy bands, Electronic conduction Electronic density of states- Effects of Nanometre length scale- How nanoscale dimension affect properties: Structural properties, Thermal properties, chemical properties, Mechanical properties, Magnetic properties, Optical properties, Electronic properties, Biological systems.	13



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PRINCIPAL
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IV	Structure and properties of Nanoparticles Metal nanoclusters: Magic numbers, Geometric structure, Electronic structure, Reactivity, Magnetic properties. Semiconducting nanoparticles: Optical properties, Photo fragmentation, coulombic explosion Carbon nanostructures: Introduction- Carbon nanoclusters-carbon nanotubes-properties-Application.	13
V	Synthesis and Characterization of Nanoparticles Top down approach(Physical method): Lithography-Ball milling-Laser induced evaporation –Pulsed laser evaporation Bottom up approach(Chemical method): Sol-gel process-Self assembly-Solvo thermal process- Electro chemical synthesis- Thermolysis. Characterization: XRD – Particle size determination-Spectroscopy(IR and Raman)-UV spectroscopy-Photo luminescence spectroscopy.	13
Total contact hours		65

Additional activities

Seminar, Assignment, Experience discussion, PPT

Text Books

- Goswami A(1996) Thin film fundamentals A New Age International
- L I Maissel and R Clang Hand book of Thin Film technology, Frey,Hartmut,Khan,Hamid
- Charles P. Poole, Frank J. Owens, (2011), *Introduction to Nanotechnology*, John Wiley & Sons, New York, (Units IV).
- Robert W.Kelsall, Ian W.Hamley,Mark Geoghegan. Nanoscale Science and Technology, John Wiley & Sons,Ltd.(III & V)

Reference Books

- Muralidharan V.S. Subramania A. *Nanoscience and Technology*. Ane Books Pvt Ltd – I Edition, New Delhi, (Units IV & V).
- Guozhong CAO, (2008). *Nano Structures And Nano Materials*. Imperial College plus, London.

Mapping

PSO/CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	S	H	S	H
CO2	S	M	S	H	H
CO3	S	H	S	H	S
CO4	S	S	S	H	H

S – Strong; H – High; M – Medium; L – Low



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Programme Code:	MSC	Programme Title:	Master of Science	
Course Code:	19PPS3E2	Title	Batch:	2019-2021
		Major Elective III: Thin film & Nano science	Semester:	III
Hrs/Week:	5		Credits:	5

Course Objective

- To develop the knowledge about fundamentals of Thin Film and Nano science

Course outcomes

K1	CO1	To understand the concepts of Thin Films
K2	CO2	To study the design of different synthesis methodologies of thin film and nanoscience
K3	CO3	To familiarize with the basics of Nanotechnology and Quantum structure
K4	CO4	To understand the characteristic techniques of various analysis

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II	Properties of thin films Optical properties: Reflection, Transmission, Absorption, Energy band gap, Transition. Electrical properties: Sheet resistance, Measurement of sheet resistance, Temperature co-efficient of resistance (TCR), Influence of thickness on resistivity, Hall effect and Magneto resistance Application: Integrated circuits	13
III	Nanoscience Introduction - classification of quantum structure –quantum confinement- Nanoscale architecture - Summary of electronic properties of atoms and solids: Free electron model and energy bands, Electronic conduction Electronic density of states- Effects of Nanometre length scale- How nanoscale dimension affect properties: Structural properties, Thermal properties, chemical properties, Mechanical properties, Magnetic properties, Optical properties, Electronic properties, Biological systems.	13



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IV	Structure and properties of Nanoparticles Metal nanoclusters: Magic numbers, Geometric structure, Electronic structure, Reactivity, Magnetic properties. Semiconducting nanoparticles: Optical properties, Photo fragmentation, coulombic explosion Carbon nanostructures: Introduction- Carbon nanoclusters-carbon nanotubes-properties-Application.	13
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Total contact hours		65

Additional activities

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Reference Books

- Muralidharan V.S. Subramania A. *Nanoscience and Technology*. Ane Books Pvt Ltd – I Edition, New Delhi, (Units IV & V).
- Guozhong CAO, (2008). *Nano Structures And Nano Materials*. Imperial College plus, London.

Mapping

PSO/CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	S	H	S	H
CO2	S	M	S	H	H
CO3	S	H	S	H	S
CO4	S	S	S	H	H

S – Strong; H – High; M – Medium; L – Low


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Programme Code:	MSC	Programme Title:	Master of Science	
Course Code:	20PPS3E2	Title	Batch:	2020-2022
		Major Elective II: Thin film & Nano science	Semester:	III
Hrs/Week:	5		Credits:	5

Course Objective

- To develop the knowledge about fundamentals of Thin Film and Nano science

Course outcomes

K1	CO1	To understand the concepts of Thin Films
K2	CO2	To study the design of different synthesis methodologies of thin film and nanoscience
K3	CO3	To familiarize with the basics of Nanotechnology and Quantum structure
K4	CO4	To understand the characteristic techniques of various analysis

Syllabus

Unit	Content	Hrs
I	Thin film Nature of thin film, Thermodynamics of nucleation, Film growth, Deposition parameters & grain size, Epitaxy, Incorporation of defects, Impurities in thin films. Deposition Techniques: Physical Vapour deposition: Thermal Evaporation, RF Sputtering, Reactive sputtering , Chemical vapour deposition: Pyrolysis, Chemical deposition: Chemical Bath deposition.	13
II	Properties of thin films Optical properties: Reflection, Transmission, Absorption, Energy band gap, Transition. Electrical properties: Sheet resistance, Measurement of sheet resistance, Temperature co-efficient of resistance (TCR), Influence of thickness on resistivity, Hall effect and Magneto resistance Application: Integrated circuits	13
III	Nanoscience Introduction, Moore's laws - classification of nanostuctures – quantum confinement- Summary of electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids , Free electron model and energy bands, Electronic conduction - How nanoscale dimension affect properties: Structural properties, Thermal properties, chemical properties, Mechanical properties, Magnetic properties, Optical properties, Electronic properties, Biological systems.	13



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IV	Structure and properties of Nanoparticles Nanofibers, inorganic nanotubes and nanowires , Metal nanoclusters: Magic numbers, Geometric structure, Electronic structure, Reactivity, Magnetic properties. Semiconducting nanoparticles: Optical properties, Photo fragmentation, coulombic explosion, excitons, SET, Carbon nanostructures: Introduction- Carbon nanoclusters-carbon nanotubes-properties-Application.	13
V	Synthesis and Characterization of Nanoparticles Growth mechanism : Vapour liquid solid growth(VLS), Vapour solid growth(VS) Top down approach (Physical method): Lithography-Ball milling -Laser induced evaporation Bottom up approach (Chemical method): Sol-gel process-Self assembly-Solvo thermal process- Electro chemical synthesis - Thermolysis, Electrospinning Characterization: XRD – Scanning tunneling microscopy- Atomic force microscopy- IR and Raman spectroscopy-UV spectroscopy-Photo luminescence spectroscopy.	13
	Total contact hours	65

Additional activities

Seminar, Assignment, Experience discussion, PPT

Text Books

- Goswami A(1996) Thin film fundamentals A New Age International
- L I Maissel and R Clang Hand book of Thin Film technology, Frey,Hartmut,Khan,Hamid
- Charles P. Poole, Frank J. Owens, (2011), *Introduction to Nanotechnology*, John Wiley & Sons, New York, (Units IV).
- Robert W.Kelsall, Ian W.Hamley,Mark Geoghegan. Nanoscale Science and Technology, John Wiley & Sons,Ltd.(III & V)

Reference Books

- Muralidharan V.S. Subramania A. *Nanoscience and Technology*. Ane Books Pvt Ltd – I Edition, New Delhi, (Units IV & V).
- Guozhong CAO, (2008). *Nano Structures And Nano Materials*. Imperial College plus, London.

Mapping

PSO/CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	H	H
CO2	H	M	H	H	M
CO3	H	H	H	H	H
CO4	H	H	H	M	H

S – Strong; H – High; M – Medium; L – Low


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PRINCIPAL
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Programme Code:	M.Sc. PHY			Programme Title:	Master of Science	
Course Code:	21PPS3E5			Title	Batch:	2021 – 2023
				Core Elective III: Thin film & Nano science	Semester:	III
Lecture Hrs./Week	5	Tutorial Hrs./Sem.	-		Credits:	5

Course Objective

To develop the knowledge about fundamentals of Thin Film and Nano science

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of Growth process of Thin film materials and familiarize with the basics of Nanotechnology and Quantum structure	K1/K2
CO2	Apply the various methodologies to fabricate materials	K3
CO3	Categorize the materials according to their size	K4
CO4	Summarize the various properties of thin materials and nanomaterials using several characterization techniques	K5
CO5	Synthesis thin-film materials and nano-materials for several applications	K6


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Mapping

PO / PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	H	M	L	L	-	L	H	H
CO2	M	H	-	-	-	-	M	H
CO3	M	M	M	H	-	-	M	H
CO4	-	-	-	H	-	-	-	H
CO5	-	-	-	-	H	M	H	H

H – High; M – Medium; L – Low

Syllabus

Unit	Content	Hrs
I	Thin film Nature of thin film, Thermodynamics of nucleation, Film growth, Deposition parameters & grain size, Epitaxy, Incorporation of defects, Impurities in thin films. Deposition Techniques: Physical Vapour deposition: Thermal Evaporation, RF Sputtering, Reactive sputtering, Chemical vapour deposition: Pyrolysis, Chemical deposition: Chemical Bath deposition.	13
II	Properties of thin films Optical properties: Reflection, Transmission, Absorption, Energy band gap, Transition. Electrical properties: Conducting properties of metal, semiconductor and insulator films, Hall effect and Magneto resistance Film Thickness Measurement: Interferometry, Fringes of equal thickness (FET), Fringes of equal chromatic order (FECO), Step gauges, Ellipsometry, Multiple beam interferometry.	13


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III	Nanoscience Introduction- Moore's laws- classification of nanostructures- quantum confinement in nanostructures- Electronic density of states- excitons- Influence of nanoscale dimension on properties: Structural properties, Thermal properties, chemical properties, Mechanical properties, Magnetic properties, Optical properties, Electronic properties, Biological systems- Metal nanoclusters- Semiconducting nanoparticles- Carbon nanostructures: Carbon nanoclusters-carbon nanotubes-properties	13
IV	Synthesis and Characterization of Nanoparticles Growth mechanism : Vapour liquid solid growth(VLS)- Vapour solid growth(VS) Top down approach (Physical method): Lithography-Ball milling -Laser induced evaporation Bottom up approach (Chemical method): Sol-gel process-Self assembly-Solvo thermal process- Electro chemical synthesis - Thermolysis Characterization: XRD – SEM -TEM- EDAX-Particle size analyzer- IR and Raman spectroscopy-UV spectroscopy-Photo luminescence spectroscopy.	13
V	Applications of Nanomaterials: NEMS – MEMS - coulomb blockade effect – SET – QDLED- Quantum dot sensitized solar cell - Quantum dot laser - Quantum cascade laser – SET - Carbon nanotube transistors - Silicon nanowire biosensor - drug delivery.	13
	Total contact hours	65


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Pedagogy and Assessment Methods:

Seminar, Power Point Presentation, Chalk and talk, Quiz, Assignments, Group Task
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Text Book

S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHERS \ EDITION	YEAR OF PUBLICATION
1	Goswami A	Thin film fundamentals	New Age International	2006
2	L. T. Meissel and R. Glang	Hand book of Thin Film technology	McGraw -Hill	1978
3	Kasturi L Chopra	Thin film phenomena	McGraw -Hill	1979
4	Charles P. Poole, Frank J. Owens,	Introduction to Nanotechnology	John Wiley & Sons, New York	2011
5	Robert W.Kelsall, Ian W. Hamley, Mark Geoghegan	Nanoscale Science and Technology	John Wiley & Sons, New York	2005



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6	Michael F. Ashby, Paulo J. Ferreira, Daniel L. Schodek	Nanomaterials, Nanotechnologies and an introduction for engineers and design architecture	Elsevier Science	2009
7	Guozhong CAO	Nano Structures and Nano Materials: Synthesis, Properties and Applications	Imperial College plus, London	2004

Reference Books

S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHERS \ EDITION	YEAR OF PUBLICATION
1	Milton Ohring	Materials Science of Thin films	Academic Press	2001
2	Muralidharan V.S. Subramania A	Nanoscience and Technology	Ane Books Pvt Ltd – I Edition, New Delhi	
3	Masuo Hosokawa, Kiyoshi Nogi, Makio Naito, Toyokazu Yokoyama	Nanoparticle Technology Handbook	Elsevier Science	2007
4	Hari Singh Nalwa	Handbook of Nanostructured Nanotechnology	Academic Press Vol(1-5)	2000
5	Related online contents [MOOC, SWAYAM, NPTEL, Websites etc] http://www.ncpre.iitb.ac.in/slotbooking/SOP/62SOP.pdf https://en.wikipedia.org/wiki/Nanomaterials https://www.nano.gov/you/nanotechnology-benefits			



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