PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

THIN FILM PHYSICS AND TECHNOLOGY

Offered to : M.Sc.(PHYSICS)	Course Code : 22PH3D4
Course Type : Domain specific elective (DSE)	Course : Thin Film Physics and Technology
Year of Introduction : 2022	Year of offering : 2022
Year of Revision : 2022	Percentage of Revision : Nil
Semester : III	Credits : 4
Hours Taught : 60 hrs. per Semester	Max.Time : 3 Hours

Course Description:
Thin Film Physics and Technology course is aimed to know its role in the design and development of miniaturised devices with higher speed in new generation of integrated circuits, which requires advanced materials in the form of thin films and their new processing techniques.

Course Objectives: The course is aimed at

1.Equipping the students with the basic understanding of how thin films are fabricated, characterized and their applications.
2. To make the student learn different physical and chemical methods of thin film deposition.
3. To introduce nucleation and growth mechanisms of thin films based on thermodynamics and molecular theory
4.To familiarize with physics and techniques involved in the measurement of thin films
5. To familiarize with experimental techniques required for characterization of thin films

Course outcomes: At the end of this course the students should be able to

CO1:Gain knowledge over Vacuum technology and principle of vacuum pumps- various types of vacuum pumps and their corresponding ranges.
CO2:Gain knowledge about various physical fabrication methods of thin films like thermal evaporation, Pulsed laser deposition, Sputtering, Epitaxy etc.
CO3:Gain knowledge about various Chemical methods of fabrication like Oxidation, pyrolysis, Various methods of chemical Vapour Deposition.
CO4: explain different theories involved in film growth and measuring techniques

CO5: Apply different characterization methods to thin films

CO - PO MATRIX								
22PH3D4	CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	CO1	H					M	M
	CO2	H					M	M
	CO3	H					M	M
	CO4	H					M	M
	CO5	H					M	M

Syllabus		
Unit	**LearningUnits**	**LectureHours**
I	**Vacuum Technology** Fundamentals of vacuum, basic definition and pressure regions of vacuum, kinetic theory of gases mean free path, types of flow, conductance, vacuum pumps and systems, rotary mechanical pump, roots pump, diffusion pump, turbo molecular pump, sputter ion pump, measurement of vacuum, concept of different gauges, capacitance gauges, Pirani gauge, ionization gauge and penning gauge, vacuum system components and operation.	12
II	**Physical Methods of Thin Film Deposition** Thermal evaporation, resistive heating, flash evaporation, laser evaporation, rf-heating, co-evaporation, electron bombardment heating, sputtering plasma, discharges and arc, sputtering variants, sputtering yield low pressure sputtering, rf-sputtering, reactive sputtering, magnetron sputtering, magnetron configurations, bias sputtering, evaporation versus sputtering.	12
III	Chemical Methods of Thin Film Deposition Electrodeposition, electrolytic deposition, electro less deposition, anodic oxidation, spray pyrolysis, spin and dip coating, chemical vapor deposition (CVD), homogenous and heterogeneous process, CVD reactions, pyrolysis, hydrogen reduction, halide disproportionation, transfer reactions, CVD processes and systems, low pressure CVD, laser enhanced CVD, metalorganic CVD (MOCVD).	12
IV	**Growth of Thin Films and Thickness Measurements** Introduction: nucleation and early stages of film growth, thermodynamic aspects of nucleation, capillary theory, thin film growth modes Volmert, Weber (VW) growth, Frank-van der Merwe (FM) growth, Stranski-Krastanov growth, thickness measurement, electrical methods, microbalance monitors, quartz crystal monitor, mechanical method (stylus), optical interference methods, ellipsometry, interference fringes.	12
V	**Characterization Methods of Thin Films** X-ray diffraction (XRD), scanning electron microscopy, transmission electron microscopy, energy dispersive analysis, Auger electron spectroscopy, X-ray photoelectron spectroscopy, Rutherford backscattering spectroscopy, secondary ion mass spectrometry.	12

Text and Reference Books:

1. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press (An Imprint of Elsevier), 2002.

2. S. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Ed., OUP, 1996.

3. Kaufmann, Characterization of Materials, 2nd Ed., Wiley, 2003.