Course Title:	**Thin Films and Vacuum Technology**
Course Code:	**PHL 7194**
Course Coordinator	**Dr. Ram Prakash**
Credits	**4**

Evaluation Scheme Total 100 Marks

Quiz (Total 20 Marks)				Assignment/Project (Total 20 marks) (Minimum Two Assignments or one Project)		Mid-Term	Major Examination	Total
Quiz I (5 marks	Quiz II (5 marks)	Quiz III (5 marks)	Quiz IV (5 marks)			20 marks) (1 ½ Hour Duration)	(40 marks) (3 Hour Duration	100 Marks

WEEKS	TOPICS TO BE COVERED
Week 1	Introduction to Thin films, Thermodynamics and Thin Film growth
Week 2	Vacuum Technology: Gas Laws, Kinetic Theory of Gases, Conductance and Throughput,
Week 3	Gas Sources in a Vacuum Chamber, Vacuum Pumps vacuum pumps (Rotary, diffusion and turbo molecular pump) and measurement gauges.
Week 4	Film Formation and Structure: Stages of thin film formation: Nucleation, Adsorption, Surface diffusion, capillarity theory of nucleation,
Week 5	statistical theory of nucleation, growth and coalescence of islands,
Week 6	grain structure and microstructure of thin films, diffusion during film growth, polycrystalline and amorphous films.
Week 7	Physical vapour deposition: Vacuum evaporation-Hertz-Knudsen equation, evaporation from a source and film thickness uniformity,
Week 8	Sputtering (Plasma Physics (DC Diode), rf Plasmas, Magnetic Fields in Plasmas, Sputtering Mechanisms) and sputtering yield,
Week 9	Sputtering of alloys; magnetron Sputtering, Reactive sputtering;
Week 10	Pulsed laser deposition (PLD). Chemical vapour deposition:
Week 11 (17th -21st March, 2025)	**Mid-Term**
2nd April, 2025	**Showing of Mid-Term Answer Sheets**
Week 13	Mechanisms, Materials, Chemistries, Systems, PECVD.

Week 14	Deposition rate, Film thickness and uniformity, Structural properties: Crystallographic properties, defects
Week 15	residual stresses, adhesion, hardness, ductility, electrical properties
Week 16	, magnetic properties; optical properties.
Week 17 (5^{th} -9^{th} May, 2025)	**Revision Week**
Week 18 (13^{th} – 22^{nd} May, 2025)	**Major Examinations**
29^{th} May, 2025	**Showing of Major Exams Answer Sheets**

Course Outcomes: Upon successful completion of this course, students will be able to:

CO1: Understand the fundamentals of thin film growth and thermodynamics **and** Apply knowledge of vacuum technology
CO2: Understand and describe the various stages of thin film formation, including nucleation, adsorption, surface diffusion, and the theories behind them
CO3: Gain proficiency in various methods of thin film preparation particularly physical vapor deposition (PVD) techniques such as vacuum evaporation and sputtering.
CO4: Develop the ability to characterize thin films using techniques to assess deposition rates, thickness, and uniformity.

Recommended Books:

1. R. K. Waits, Thin Film Deposition and Patterning, American Vacuum Society, 1998.
2. M. Ohring, The Materials Science of Thin Films, Academic Press, Boston, 1991.
3. LudmilaEckertova, Physics of Thin Films, 2nd Plenum Press New York, 1986
4. Kasturi L. Chopra, Thin Film Phenomena (McGraw-Hill, 1969)

Calendar of Quizzes/Assignment etc. to be provided as per below details and exact dates to be fixed in consultation with other course coordinators to avoid overlap of Quizzes of different courses.

Component	**Date**
Quiz-I	**27^{th} -31^{st}, January 2025**
Quiz-II	**24^{th} -28^{th} February, 2025**
Assignment-I	**10^{th} -12^{th} February, 2025**
Mid-Term	**17-21^{st} March, 2025**
Assignment-II/ Project Submission	**21^{st} – 24^{th} April, 2025**
Quiz-III	**7^{th} – 11^{th} April, 2025**
Quiz-IV	**28^{th} April-2nd, May, 2025**
Major Exam	**13^{th} – 22^{nd} May, 2025**

Note:

1. One surprise Quiz may be fixed out of Quiz-II, Quiz-III or Quiz-IV.
2. In case of any deviation in evaluation methodology for courses such as AEC/VAC/SEC shall be mentioned accordingly. Thus, same shall be approved by the next BOS of school if not done earlier.

Signature of Course Coordinator :