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**SECOND SEMESTER 2022 - 2023**

# Course Handout Part II

16.01.2023

In addition to Part I (general Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

### Course No. : PHY F379

# Course Title : Thin film technology

## Instructors : **Prof. Harihara Venkataraman** & Prof. V. Satya Narayan Murthy

**Course Description:** This course gives an overview of thin film technology - Basics of vacuum science and technology, Thin film deposition techniques; Kinetics and diffusion mechanisms, Surface nucleation and film growth, Structure and morphology of thin films, Electrical and magnetic properties, Special topics on thin film application.

**Scope & Objective:**

* The course introduces the concepts in vacuum deposition techniques, nucleation and growth of thin films.
* Techniques to characterize the thin films and some of the physical properties of films and their applications.

**Text Book:** No single textbook exists. Lecture notes will be distributed.

**Reference Books:**

* Materials Science of Thin Films – Milton Ohring, 2nd Edition (Elsevier)
* A User’s Guide to Vacuum Technology - J.F. O’ Hanlan
* Thin film deposition principles and practice – Smith Donald
* Thin Film Phenomena – Kasturi L Chopra (McGraw - Hill)

**Course Plan:**

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| --- | --- | --- | --- |
| ***Lecture No.*** | ***Learning Objectives*** | ***Topics to be covered*** | ***Reference (Chap/Sec)*** |
| 1 - 6 | Vacuum technology | Mean free path; gas flow regimes; conductance; pumping speed; vacuum levels; working principles of different vacuum pumps; vacuum gauges; vacuum leak detection; vacuum seals. | Lecture notes and relevant portions from reference books. |
| 7 - 10 | Thin film deposition | Differences between CVD and PVD; PVD techniques – thermal and electron beam evaporation, sputtering, PLD, MBE; CVD techniques – APCVD, LPCVD, MOCVD, PECVD; evaporation rate; evaporation of multi element materials and alloys. |
| 11 - 14 | Film thickness uniformity and purity | Thickness measurement techniques; deposition geometry; thickness uniformity |
| 15 - 20 | Nucleation and growth of thin film | Thermodynamic aspects of nucleation and growth - capillarity theory of heterogeneous nucleation; atomistic theory; growth modes |
| 21 - 28 | Characterization techniques | Review of Materials Science, Structural techniques (XRD), Imaging techniques (SEM / TEM) & optical techniques |
| 29 - 34 | Properties of thin films | Electrical, dielectric, ferroelectric and magnetic properties |
| 35 - 40 | Applications | Sensors, solar cells, giant magnetoresistance, ferroelectric & multiferroics devices |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- | --- |
| **EC No.** | **Evaluation Scheme** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of**  **Component** |
| **1.** | Mid Semester Examination | 90 min | 35 | 18/03 4.00 - 5.30PM | Closed Book |
| **2.** | Quizzes | 30 min | 25 | To be announced in the class | Open Book |
| **3.** | Comprehensive Examination | 180 min | 40 | 20/05 AN | Closed Book |

**\*Two quizzes will be conducted, and the best performance will be considered. No makeup for the quizzes for any reason.**

**Notices:** Notices concerning the course will be put on **CMS**.

**Makeup Policy:** Makeup requests may be considered only in case of severe medical illness leading to hospitalization with proper medical proof, and also, prior permission is required for MID - SEM and Comprehensive Examination.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester, and no type of academic dishonesty is acceptable.

Instructor-in-Charge

PHY F379