MANGALORE UNIVERSITY

Department of Materials Science

MSc Materials Science

MSS 503: **THIN FILMS** (3 Credits)

Objectives: The course introduces the student to an extremely important form of material, thin films. The present day technology ranging from astronomy to zoology spanning microelectronics, optical coatings, protective and decorative coatings, sensors etc. requires a sound understanding of thin film concepts. The preparation techniques, optical and electrical properties are dealt in considerable detail.

Expected course outcomes: The student should be well versed with the fundamentals of thin films, deposition parameters affecting the structure thereby properties so that without further theoretical training students can be inducted in to the industry or research in the area of thin films.

Unit I

Preparation of Thick and Thin Film Materials: Definition of thick and thin films. Physical Vapour Deposition(PVD) - thermal evaporation - Knudsen cosine law. Sputtering- DC Glow discharge and Low pressure sputtering. Chemical Vapour Deposition(CVD). MBE, MOCVD methods of preparing device grade films. Spray pyrolysis and other chemical methods of film preparation for large area applications. LB films and their applications. Thickness measurement techniques- electrical, and mechanical methods. Optical methods- spectrophotometric and interference methods. Microbalance methods – Quartz crystal oscillator technique. 14 hours

Unit II

Nucleation and Growth of Thin Films: Theories of nucleation-Capillarity theory, effect of deposition parameters. atomistic theory and rate equation approach of nucleation. Growth of thin films- Mechanisms and influence of deposition parameters. Epitaxial growth - theory of epitaxial nucleation. Durability of films - Adhesion and Internal stress.

Optical Properties of Thin Films: Reflection and Transmission at interface between isotropic transparent media. Reflectance and Transmitance in thin films. Methods for determining optical constants - spectrophotometer and polarimetric methods. Antireflection coatings - theory and design of single layer coatings. Double and multilayer coatings - brief description. 14 hours

Unit III

Electron Transport Phenomena in Thin Films: Electrical conduction in discontinuous metal films - Quantum mechanical tunneling model. Conduction in continuous metal films- Size effect and specular scattering. Thermoelectric power in metal films. Electrical conduction in semi-conductor and insulator films - Hybrid micro circuits, thin film resistors, thermopiles. Quantum Hall Effect- Quantum well devices.

14 hours

References

1. Handbook of Thin Film Technology – L I Maissel and R Glang (Ed) (McGraw Hill, 1970)
2. Vacuum Deposition of Thin Films – L Holland (Wiley, 1956)
3. Thin Film Phenomena – K L Chopra (Mc Graw Hill, 1969)
4. Physics of Thin Films Vol.1 - 4 - G Hass and R E Thun (Ed) (Academic, 1963)
5. Electrical Conduction in Thin Metal Films – T J Coutts (Elsevier, 1974)
6. Optical Properties of Thin Solid Films – O S Heavens (Dover, 1955)
7. Thin Film Technology and Applications – K L Chopra and L K Malhothra (Ed) (Tata Mc Graw Hill, 1985)