GUJARAT TECHNOLOGICAL UNIVERSITY

METALLURGY ENGINEERING (21)
THIN FILM AND NANO-TECHNOLOGY
SUBJECT CODE: 2182114
B.E. 8th SEMESTER

Type of course: Engineering Science

Prerequisite: Knowledge of Material Science and Metallurgy

Rationale: Thin Film and Nano-Technology subject will prepare students for careers in Engineering. This subject provides information about Thin Film and Nano-materials; their production, properties and applications which will be useful for effective management in industry. This education at the undergraduate level will enable students to seek employment in Metal Industries upon graduation while at the same time, provide a firm foundation for the pursuit of post graduate studies in Metallurgy Engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Thin Film, various methods of thin film preparation, their advantages and limitations, evaporation of alloys, compounds and mixtures.	**12**	20
2	Nature of thin film, condensation, nucleation and growth of thin films, Determination of structure of thin films, film thickness measurements. Properties & Application of thin films.	**12**	20
3	Introduction to nanomaterials and nanotechnology, scope & applications of nanotechnology. Classifications and types of nanomaterials. Basic understanding of various phenomena at nano scale namely size confinement, interfacial surface phenomena. Introduction to basic building blocks namely atoms, molecules, self-assembly, carbon nanotubes, nanocrystals, nanoclusters, nanocapsules, fullerenes, quantum dots, quantum wires and nanoporous materials. Functional properties of nanomaterials , Size dependence of material at nano scale. Bulk vs nano properties of materials.	**15**	25
4	Synthesis & fabrication techniques: 'Top down' vs 'Bottom-up' approach of synthesis. Review of synthesis methods namely sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma deposition process, microemulsion technique, inert gas condensation, mechanical milling, devitrification of amorphous phases, etc. Applications of nanomaterials namely nanograined structural materials & nanocomposites, nanomagnetic materials, chemical applications etc.	**21**	35

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**30**	**10**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Thin film Phenomena, K. L. Chopra, Mc.Graw-Hill Pub. Co. N.Y.
2. Thin film Technology and Applications, K. L. Chopra and L. K. Malhotra, McGrawHill, New York.
3. Handbook of Thin film Technology, L. T. Maissel and R. Glang, McGraw-Hill, Pub. Co. New York.
4. Active and Passive Thin Film Devices, J. J. Coutts, Academic Press.
5. Nanomaterials: Synthesis, Properties & Applications, ed. by A.S. Edelstein and R.C. Cammarata, published by Institute of Physics, UK.
6. Nanostructured Materials: Professing, Properties and Applications, ed. by C.C. Koch, William Andrew Publishing, New York.
7. Nanotechnology by George Timp, Springer-Verlag, New York.
8. Nanoparticles and Nanostructured Films: Preparation, characterization & Applications, ed. by J.H. Fendler, John Willey & Sons.
9. Handbook of Nanophase and Nanostructured Materials, ed. by Z.L. Wang, Z. Zhang and Y. Lim, Kluwer Academic Publisher, 2002.
10. Handbook of Nanostructured Materials and Nanotechnology, ed. by H.S. Nalwa, Vol. 1-5, Academic Press.
11. Carbon Nanotubes: Science and Applications ed. by M. Meyyappan, CRC Press, Boca Raton Florida.
12. Processing and Properties of Structural Nanomaterials, Leon L. Shaw, C. Suryanarayana & Rajiv S. Mishra, TMS, 2003.

Course Outcome:

After learning the course the students should be able to:

- Understand production, properties and applications of Thin Film.
- Understand production, properties and applications of Nano-materials.

List of Open Source Software/learning website:

I. http://nptel.iitm.ac.in/
II. www.ocw.mit.edu

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be submitted to GTU.